ELEMENTS
OF
MILITARY HYGIENE

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MEDICAL FIELD SERVICE SCHOOL
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Second Edition 1942

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FOREWORD

The Department of Military Sanitation, Medical Field Service School has prepared this book for the instruction of First Classmen at the United States Military Academy in the elements of military hygiene and first aid. Special emphasis has been given to the requirements of field service and military aviation.

In order to give the reader a sufficient background for understanding and applying the general subject matter, some space has been given to the rudiments of human anatomy and physiology.

Many of the illustrations were taken from "Military Preventive Medicine", Third Edition, by Dunham.

CONTENTS

LIST OF ILLUSTRATIONS

CHAPTER I.

INTRODUCTION TO MILITARY HYGIENE

There is no subject of greater importance to an officer than one dealing with the preservation of the health of the soldier and the prevention of disease in the Army. The best equipment and training is of little avail if men fall sick before they can put their training and skill at arms into practice; and furthermore, the best laid schemes of the most brilliant commanders will be upset if there occur extensive outbreaks of disease at a critical period of the campaign.

Definition. Hygiene is that branch of the medical science which deals with the preservation of health. Sanitation is the art through which practical application is made of our knowledge of hygiene. Military hygiene embraces all matters pertaining to military preventive medicine and military sanitation. The objectives of military hygiene are the prevention and control of disease among components of the military forces, and the maintenance and conservation of the health and physical fitness of troops. Its ultimate aim is the building and maintenance of the maximum physical efficiency of the fighting forces.

Historical. The majority of the diseases of armies are preventable. Their causes are known and they can be avoided by constant attention to certain simple sanitary rules; yet, owing to neglect or ignorance of these rules, the number of sick in wars previous to the Great War of 1914-1918, reached enormous figures and, except in very short campaigns, deaths from disease have always far exceeded those from wounds. Authorities familiar with statistics of past wars regard it as inevitable that at least 4 soldiers must perish from disease to 1 killed by enemy fire. This has been true in all of our wars.

The Canadian invasion by Arnold and Montgomery in 1725 failed chiefly because of heavy losses from smallpox and dysentery. In the Mexican War, it was much safer facing bullets on the battlefields leading up to Mexico City than it was to do guard duty in the midst of malaria and yellow fever around the Port of Vera Cruz. There were seven times as many deaths from

disease as from battle wounds during the two years of the Mexican War. In our Civil War three-fourths of the deaths in the two armies were due to disease. In the Spanish-American War more than 10 soldiers needlessly perished from preventable diseases for every man who died from bullets. A keener appreciation of simple rules of sanitation on the part of the officers of the Army would have prevented these deaths. In the first world war there were 50,000 deaths due to battle and 58,000 deaths from disease. Of course, it was at this time that influenza was sweeping over the world. This epidemic found the world in arms, with a general breakdown of normal living and sanitary conditions. Our men were concentrated in crowded camps and barracks, trains and boats and because of the overcrowding, they developed the disease in large numbers.

European armies have fared no better than the Americans. In the Turko-Russian War of 1878, 80,000 men died of disease, while only 20,000 died of wounds. In the Crimean War the allied armies lost 50,000 from disease as compared to 2,000 from bullets. In the Boer War twice as many soldiers died of disease as were killed by enemy bullets.

Our history books are full of examples of military expeditions that had to be abandoned and strongly fortified areas that had to be surrendered to the enemy because of disease. Moreover, not only may disease seriously reduce the fighting strength, but large numbers of sick are an actual hinderance to an army in the field, requiring for their evacuation and treatment the maintenance of large establishments of personnel and transport, which could more profitably be employed to further the military effort.

It will, therefore, be seen that measures necessary to maintain health and prevent disease are not the concern of the Medical Department alone, but are matters of vital military importance and concern every officer in the military establishment.

Progress. Great advances have been made in the past century in disease prevention. The sciences of bacteriology and parasitology, resulting in the identification of the causative organisms of many of the most dreaded infectious diseases, have materially aided in our control of disease, and preventive medicine has removed entirely the menace of many of the most

dangerous. The use of inoculations with vaccines and serums has had an important part in these results, but practical sanitation has had its triumphs, almost as spectacular. Smallpox and typhoid fever occur but rarely among our military personnel, and when they do occur they are of a mild form. Yellow fever, which formerly was a terrible scourge in our southern stations, has practically disappeared in these regions as the result of applied sanitation alone. Malaria, one of the most serious communicable diseases in the world, today can be prevented by mosquito control measures. The venereal diseases have been greatly reduced in numbers among our troops as the result of education and prophylactic measures. Intestinal diseases, although still a menace to troops, are preventable by maintenance of sanitary conditions in and about messes, and by the use of proper food and drink. The respiratory diseases are those in which we seem to be lacking in adequate control measures, although their prevention is largely dependent upon adequate barrack room space and proper ventilation. So it may be stated that preventive medicine provides a means for the control of many of the diseases that formerly were prone to occur in epidemic form whenever and wherever an army was mobilized.

Officer's Responsibility. A very important responsibility rests on the officer for the maintenance of the health of the troops he commands. In the routine duties of a company commander, the supervision of the hygiene of his company is as much his concern as is the instruction in drill. Medical officers function in an advisory capacity and initiate and supervise matters of sanitation, but the responsibility for carrying out sanitary measures is definitely up to those who exercise command. This fact is clearly stated in Army Regulations — "Commanding officers of all grades are responsible for sanitation and for the enforcement of the provisions of sanitary regulations within their organizations, and the boundaries of areas occupied by them. Commanding officers will take such steps as they may deem practicable and feasible to correct sanitary defects."

Conclusion. In spite of our increased knowledge as to the cause of many diseases and in spite of the control measures now available, sickness among military personnel is inevitable.

Measures to lower the incidence of disease require the utmost vigilance on the part of all officers who command. Our Army must be prepared for service in all climates and under conditions of extreme heat and extreme cold, in desert wastes and impenetrable jungles. Malaria, venereal diseases, yellow fever, typhus, dysentery, heat stroke, frost bite, tropical sores and a host of other conditions, menace our troops. Officers of the line must work hand in hand with officers of the Medical Department in protecting the men from ravages of disease.

A very important responsibility of a commanding officer is the care of his troops, and upon such care depends the conservation of man power, the maintenance of morale and, in the last analysis, the efficiency of the military organization and its ability to meet the supreme test — the test of war.

CHAPTER II

ANATOMY AND PHYSIOLOGY

General Structure. The human body consists of a bony or skeletal framework which supports the soft parts or tissues. As a preliminary to the description of the gross appearance of the separate parts of the body it is appropriate that consideration be given to the finer structure of the tissues.

Minute Anatomy. The structural unit of every part of the human body is the microscopic animal cell, and the various activities of the body result from the activities of the cells which compose it.

These body cells vary in size and shape, but all are very minute, the largest rarely exceeding 1/5 of a millimeter in diameter. In some parts of the body they lie side by side; in other parts they may be separated from one another to a varying degree by an intercellular substance. They differ greatly in structure and function. Muscle cells are long fibers having the power to contract; bone cells form the hardest and most enduring tissue in the body; nerve cells possess elongated processes whose special function is conductivity; the cells of the skin are very flat, especially those comprising the outermost layers, and their function is principally a protective one.

A cell may be defined as living matter called *protoplasm,* surrounded by a membrane and containing a smaller, denser inner body called the nucleus or kernel. The protoplasm is a colorless, semi-transparent, gelatinous, mobile and irritable substance which is the "physical basis of life." One of the principal constituent parts of the protoplasm of the nucleus is *chromatin,* which carries all of the hereditary potentialities of the individual and is directly concerned in the reproduction, or division, of the cell.

When cells with similar structure and function are grouped together there is formed what is known as *tissue.* Between these cells there are always small spaces even in the most compact tissue. There are points of union between cell and cell, but the

intercellular spaces are necessary in order that each cell may be in contact with the fluids of the body in which nourishment is carried to the cell and waste products are removed. This interchange takes place through the cell membrane.

In considering the properties of protoplasm we find that it is a mixture of complex organic and simpler inorganic substances. The organic substances comprise principally proteins, fats, lipoids, and carbohydrates, while the inorganic substances are water and many chemical elements.

Protoplasm has the power to absorb oxygen and oxidize, or burn, some of its substance, thus producing heat energy. It is able to take up certain chemical compounds, or non-living materials, as food and convert them into its own substance, causing repair and growth. This power of nutrition is known as metabolism. Photoplasm is irritable and responds to stimulation. It has the capacity for motion.

Development of the body. The human body is developed from a single cell called the *ovum.* The ovum divides and subdivides, and the daughter cells thus formed arrange themselves as a membrane comprising three layers of cells. The outer layer is the *ectoderm,* the middle layer the *mesoderm,* and the inner layer, the *entoderm.* These three layers of cells later in the process of development assume different sizes and shapes forming the various types of cells found in the body; for example, from the ectoderm come the skin and nerve cells; the muscle cells derive from the mesoderm; the entoderm provides the lining cells of the intestines. As stated above, collections of cells of like structure and function form tissues. Combinations of tissues form body organs or structures. The characteristics of tissue depend upon the type of cells and of the intercellular substance composing it, and the structure of any organ depends upon the properties of the tissue of which it is composed.

Varieties of tissues. Some tissues perform but one physiologic function, others perform several. It is therefore difficult to classify tissues in this way except by the most important of their physiological functions.

The following arrangement has been suggested by several authorities:

Undifferentiated tissues. Composed of cells which have developed along no special line but retain the properties of the cells forming the very young body before cell differentiation takes place. Lymph and white blood corpuscles are examples of this tissue.

Supporting tissues. This type of tissue is used to support and protect more delicate tissue and to resist strain or pressure.

Nutritive tissues. These form a large group and include assimilative, eliminative and respiratory tissue.

Storage tissues. These tissues are composed of storage cells of which fat cells and liver cells are examples. These cells store reserve supplies of food which they supply when needed.

Excitable or irritable tissues. Tissues which are especially susceptible to changes in their surroundings and are therefore useful in giving to the body information as to what is going on around it. Any change in the environment which serves to arouse response in an excitable tissue is called a *stimulus.*

Conductive tissues. Serve to bring into communication the various parts of the body. This is exhibited to a very high degree by nervous tissue.

Motor tissues. The two best examples of this type of tissue are muscular tissue and the ciliated cells which line certain organs of the body. These cells have fine thread-like appendages which are kept in constant motion. These appendages are called *cilia.* The constant motion of the cilia causes material on the surface to be moved along in one direction or another.

Protective tissues. As the name indicates these tissues line or protect certain parts of the body as the enamel of the teeth, the epithelium covering the body, etc.

Reproductive tissues. These tissues are concerned in the production of new individuals. The different sexes have different types which conjoin for the origination of offspring.

Various types of these tissues are combined to form the different parts of the body.

Skeletal System. The skeletal or bony structure of the body is made up of over 200 bones. It has a threefold function: first, to support the body; second, to afford protection to certain

organs of the body which might easily be injured; third, it furnishes a system of levers which when acted upon by the muscles causes the body to move.

The skeleton may be divided for descriptive purposes into the *axial* skeleton, which includes the skull, the spine, the breastbone and the ribs, and the *appendicular* skeleton which is composed of the bones of the arms and the legs and the bones by means of which these appendages are attached to the axial skeleton.

In describing the important parts of the skeleton consideration first will be given to the skull.

The *skull* is made up of 22 bones, 8 of which form the cranium, and 14 the face. Of the cranial bones, the one forming the forehead is the *frontal* bone. The top of the skull is formed by the two *parietal* bones, In the back is the *occipital* bone, and at either side is the *temporal* bone, the upper part of which corresponds to the temple, the lower part including the ear. In addition to these there are the *sphenoidal* bone, which forms a part of the floor of the cranium, and the *ethmoid* which lies in front and forms the roof of the nasal cavity. The more important bones of the face are the *nasal* bones, which form the bridge of the nose; the two *malar*, or cheek, bones; the two upper and one lower jaw bones.

These bones of the skull, with the exception of the lower jaw bone are, in the adult, immovably joined together. At the back part of the base of the skull is the large opening through which the spinal cord passes from the spinal column on its way to the brain.

The spine or vertebral column consists of 26 irregularly shaped bones, all possessing a general sameness in outline except for modifications in the several parts of the column. Each has a flattened body at the back of which appears the arch which serves to enclose and protect the spinal cord. Spinous processes project posteriorly and lateral processes from the sides of the vertebral arches, their principal purpose being to limit the movement of the intervertebral joint.

The thoracic wall consists of the *sternum,* or breastbone, 12 ribs on either side and the vertebral column at the back.

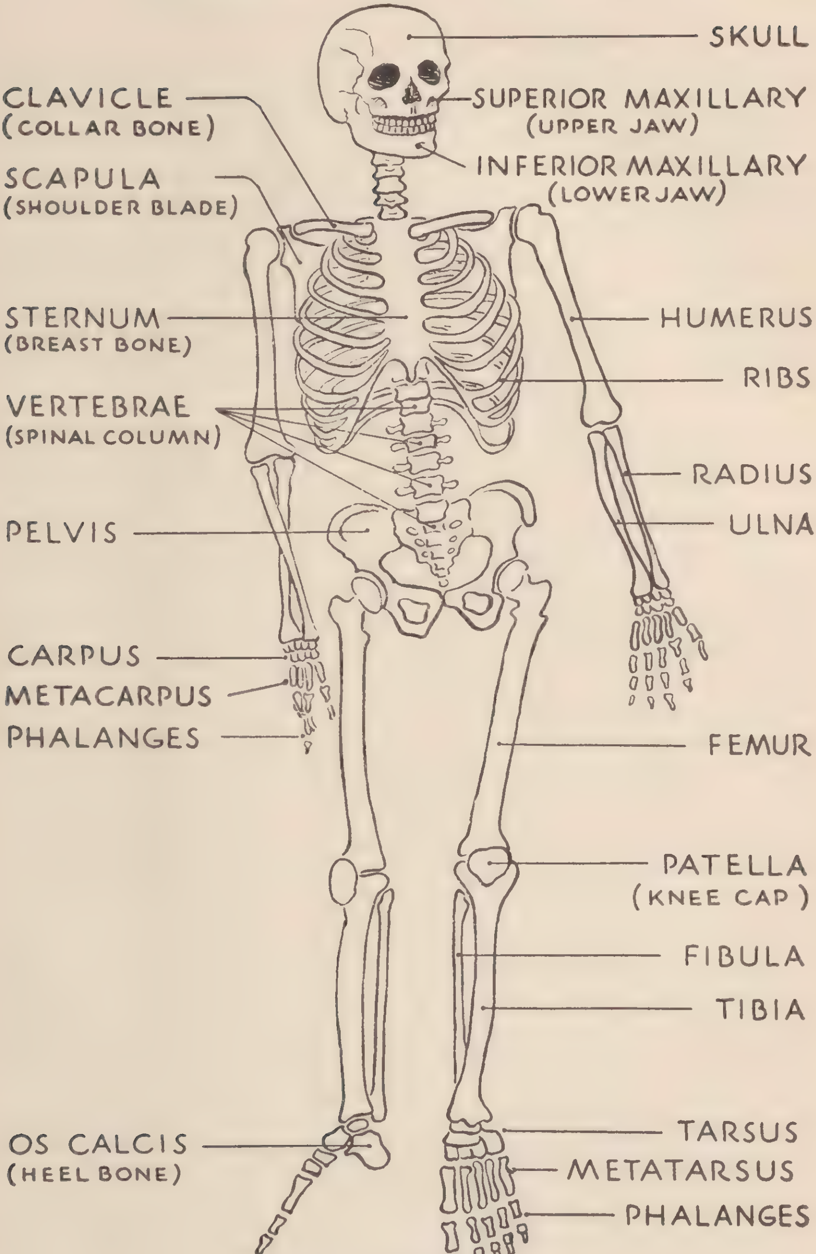

Fig. 1. Body Skeleton.

While all of the ribs articulate with the vertebral column only the upper 7 pairs are connected directly, by means of cartilage, with the sternum. These are called true ribs. The next lowermost three pairs of ribs have their cartilages attached to the rib above. The remaining two pairs have no anterior cartilaginous attachments. These five pairs of ribs are spoken of as false ribs.

The shoulder girdle consists of the *scapula* or shoulder blade, and the *clavicle* or collar bone. The scapula lies embedded in the muscles on the outside of the ribs and at the sides of the vertebral column and to it is articulated the arm bone. The clavicle serves to keep the scapula in place.

The pelvic girdle consists of the hip bone on either side and the wedge-shaped base of the spinal column, the *sacrum,* at the back. Each hip bone possesses a deep socket into which the head of the thigh bone articulates.

The upper and lower limbs may be considered at one and the same time for each contains 30 bones, the arrangement of which in each is very similar. The differences in structure have resulted from changes in function resulting from adaptation of the upper limb to prehensile purposes and the lower to weight bearing and locomotion. The socket of the scapula into which the round head of the humerus fits is shallow and this fact together with the relative looseness of attachment of the shoulder girdle permits a wide range of motion at the shoulder. The articulation of the arm and forearm at the elbow permits not only flexion and extension, but also pronation and supination of the forearm by reason of the rotating power of the radius over the ulna. The eight small wrist bones are loosely connected together by ligaments enhancing great freedom of movement. Then, too, the elongated digits, more especially the thumb which is opposable to any of the other fingers permits the hand to grasp and manipulate objects readily. The lower limb would serve no good purpose were its flexibility as great as that of the upper limb. Since it must bear the weight of the body its bones must be sturdier, therfore heavier than the corresponding bones of the upper extremity. The hip girdle, unlike the shoulder girdle, is firmly fixed; the socket of the hip bone into which the femur fits, is much deeper than the socket of the scapula, consequently, while there is

a limitation of flexibility at the hip joint there is also considerably less of a liability to dislocation than there is at the shoulder. In the knee there is very little more than a forward motion, and because the fibula, the more slender of the two leg bones, is at tached firmly to the upper end of the tibia, pronation and supination are lacking in the leg. The bones of the foot which correspond to the bones of the wrist are larger, and being closely bound together by ligaments do not possess a similar degree of freedom of motion. But because there must be elasticity to permit springiness in the step so as to avoid jarring, the bones of the foot are arranged in arch formation. The bones of the toes are much shorter than those of the fingers, consequently they are less flexible, and because the great toe cannot be opposed to any of the other toes the foot lacks prehensile qualities.

Development of bone. When a child is born the bones of the body, although formed, are not continuous masses of bony tissue. Each is partly composed of cartilage. The process of bone formation is very complicated and in these areas of cartilage starts from small points or centers of ossification. These centers finally enlarge and when adult life is reached have replaced all of the cartilaginous tissue.

In the large bone of the arm in a child both ends are separated from the shaft by cartilage and it is in these areas that the bone grows in length by new cartilage appearing and later being replaced by bone. The bone grows in thickness by new bony tissue being formed beneath the covering membrane or *periosteum*.

The bones of children are quite flexible but as old age comes on this flexibility is slowly lost and they become very brittle.

Joints. Where two bones of the skeleton come into apposition they form a *joint* or *articulation*. Some joints permit of no motion while others permit motion in many directions. The principal kinds of joints are the following:

Fixed joints. Best illustrated by the union between certain bones of the skull which permit of no motion and are called *sutures*.

Ball-and-socket joints. As the name implies, in a joint of this type the rounded end of one bone fits into a hollowed sur-

face of the other and its characteristic is that it permits a greater degree of motion than do other joints. The shoulder and hip joints are examples.

At the hip joint the thigh may be flexed, that is, moved upwards and forwards, or extended, that is, moved backwards. It may be moved toward or away from the other thigh, and it may be made to produce a cone like motion, the apex of the cone being at the joint, which is in reality a combination of the other possible motions.

Hinge joints. A joint of this type permits of a movement in one plane as in a hinge. The knee joint is one of the best examples of this kind of a joint.

Pivot joints. The best example of this type is between the first and second bones of the spine. One bone rotates around another which remains stationary.

Gliding joints. In the closely packed bones of the wrist, for example, little motion is permitted except that provided by one of the bones sliding a short distance over the surface of the other.

The Muscular System. The muscles make up the main motor organs of the body. There are three types of muscle tissue:

Voluntary muscles which are under our control and may be moved at will. These make up the mass of skeletal muscles and on account of their appearance under the microscope are sometimes called *striped* muscles.

Involuntary muscles are not fixed to the skeleton but largely surround cavities or tubes in the body. These muscles act without our will and from their microscopic appearance are called *smooth* muscle. The muscles surrounding the stomach are examples of this type.

Heart muscle is involuntary muscle but differs somewhat from other involuntary muscle tissue when examined under the microscope. In fact it more closely resembles voluntary muscle.

Relationship of the bones and attached muscles. Muscles are attached by means of *tendons* to the bones of the body and by their contractions cause parts of the body to move. The point where one tendon is attached is called the *origin* of the muscle and where the other end is attached is called the *insertion.* The

origin is usually in that part of the skeleton which is less freely movable than the part to which the insertion is attached. Muscles are of various sizes and shapes and may have a tendon only at one end or along one side depending on the function of the muscle.

When the muscles serve to move bones they act as levers. The most common muscular movements used are levers of the third order where the power is between the weight and the fulcrum. An example of this may be seen in bending the forearm. The fulcrum here is the elbow joint and the power is applied by muscles having their insertion in the bones of the forearm and the weight being the weight of the hand itself. Some other motions of the body illustrate levers of the first and second order; for example, the nodding movement of the head illustrates a lever of the first order and the act of standing on the toes illustrates one of the second order.

Activity of voluntary and involuntary muscles. When we send a nervous impulse to a voluntary muscle, the muscle moves either rapidly or slowly as we will it to. On the other hand, involuntary muscle acts without any direction sent to it by our will and may contract at varying intervals like the muscles of the stomach and intestines or may stay in an almost permanent state of contraction.

Posture. The posture of the body is applied to those positions of equilibrium of the body, such as standing, sitting or lying, which can be maintained for some time. When the body is held in any one of these positions there is always a slight, sustained contracture of the muscles to prevent the joints from bending. This is called *tonus.* If the position is held for any considerable length of time a certain amount of fatigue is produced, and should the muscles be not in a healthy condition this fatigue is produced earlier than if they were healthy. The result of this fatigue causes relaxation of the muscles and improper posture. When a person not well developed stands erect for a long period the muscular relaxation or lack of tone causes him to slump.

Effect of exercise on muscle. Good food, pure air, and and a proper functioning of the body are necessary for the

healthy working of the body. In addition to these, the muscles must be exercised. In fact, a muscle must be exercised in order to get the proper nourishment, as each muscle acts as a sort of chemical engine and the contraction and relaxation are required to throw off waste products and take in new fuel from the surrounding body fluids.

When a muscle is not used at all it becomes much smaller and wastes away. This is called *atrophy* of the muscle. On the other hand, when any muscle or group of muscles are used over and over again in excess of normal the muscles become larger or undergo *hypertrophy.* The calf muscles of runners are examples of this. In hypertrophy the muscle cells become larger but do not increase in number.

The Heart and Circulation. The heart, together with the blood vessels form what is known as the *cardio-vascular system.* This system consists of a series of closed tubes of various sizes (arteries, veins and capillaries) through which the blood circulates, being propelled by a muscular pump, the heart. This system of vessels leads to and from all the tissues of the body.

Blood vessels. The tubes or blood vessels which carry the blood away from the heart are called *arteries,* while the vessels returning the blood to the heart are called *veins.*

Connecting the arteries and veins in the various tissues are minute hair-sized vessels known as *capillaries.* These have very thin walls and form dense networks throughout the body and it is through these net-works that the blood comes in close contact with the tissues of the body in order to give up food and oxygen and take away the various waste products.

The heart. The heart is a large hollow cone-shaped organ of muscular tissue about the size of a fist. It is enclosed in a tough fibrous sac, the *pericardium.* The heart is situated between the lungs near the front part of the chest where it is well protected by the bony skeleton.

The heart is divided vertically into two lateral halves which do not have any opening between so that we really have two hearts, a right and a left. Each side of the heart is made up of two cavities, an *auricle* and a *ventricle,* the auricles being smaller, thinner walled and situated above the ventricles.

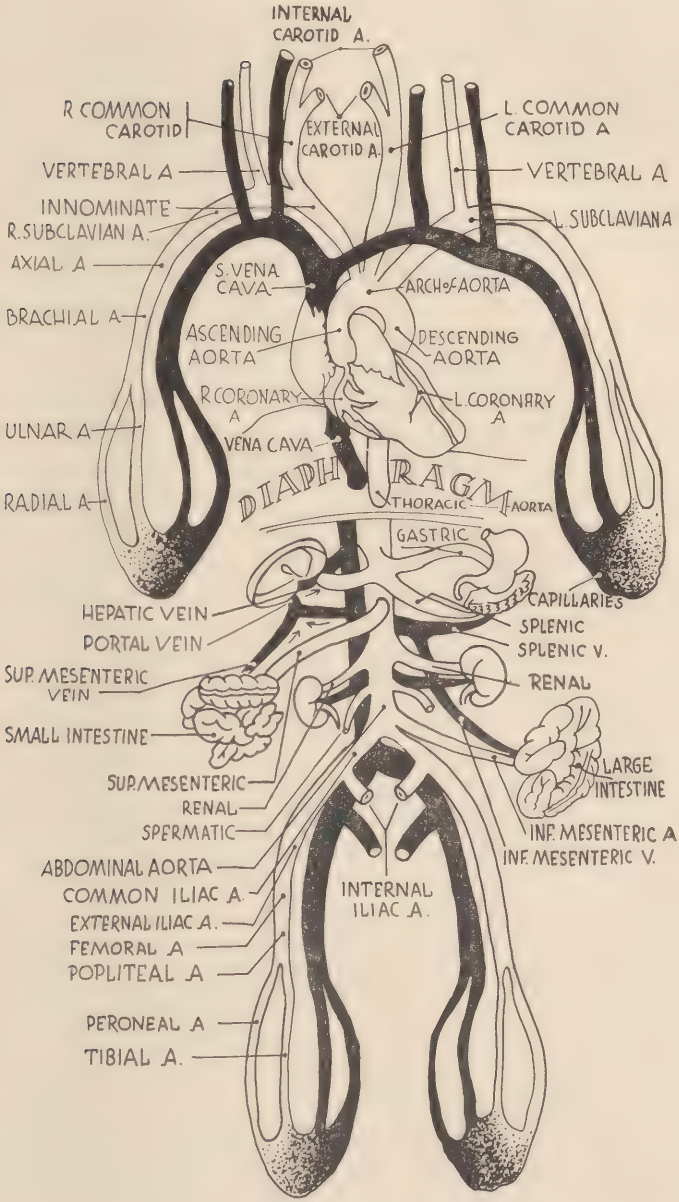

Fig. 2. Blood vascular system.

The right side of the heart is called the venous side as it receives into its auricle the impure blood collected by the veins. From the right auricle the blood passes to the right ventricle and then to the lungs to be purified. When purified it is returned to the left auricle and from there to the left ventricle which by its powerful contractions forces the blood out through the arteries to the various parts of the body.

It will be seen from the previous paragraph that there are really two circulatory systems connected with the heart. The one going through the lungs which is called the *pulmonary* circulation and the one going through the body, the *systemic* circulation.

There is still a third circulatory system although this is not directly connected with the heart. This is the *portal* system. When that portion of the blood leaving the heart in the systemic circulation goes to the stomach, intestines, spleen and pancreas, it is collected in a vein called the *portal vein* which enters the liver and breaks up into capillaries. The blood subsequently is collected by ordinary veins for return to the heart. This portal system is very important as it brings food material from the alimentary tract to the liver to be acted upon by that organ and either placed in the circulation or stored for future use.

The blood. The total quantity of blood is usually estimated at one-twelfth of the weight of the body, approximately a gallon and a half for an average adult.

The color of the blood, due to variation in its oxygen content, is bright red in the arteries and dark red in the veins. It is composed of cells or corpuscles, floating in a liquid called the *plasma.*

The plasma is composed of *fibrin* and a true liquid element called *serum.* The fibrin is the active agent in causing the blood to clot or coagulate when bleeding occurs. The serum, which is plasma less fibrin, contains the food elements of the blood. There are three types of cells or corpuscles:

The red cells or *erythrocytes* are round, flattened discs, slightly concave on each side and composed largely of *hemoglobin.* This substance contains iron and has the capacity of carrying large amounts of oxygen. The number of red corpuscles is

5,000,000 per cubic millimeter in the male and 4,500,000 in the female.

The white calls or *leucocytes* are spherical in shape and slightly larger than the red cells. They number between 5,000 and 7,000 per cubic millimeter. They are capable of changing their form and passing through the unbroken walls of the blood vessels. These cells are capable of destroying disease-producing organisms. In the presence of most infections the number of these cells greatly increases. They form the first line of defense against infection.

The blood platelets are very small and almost colorless cells. The average number may be given as 300,000 per cubic millimeter. It is believed that their function is to aid clotting of the blood and to maintain immunity against certain diseases.

In addition to the cells described above there are several other cells occurring in small numbers of which very little is known.

Lymphatic System. The lymphatic system is much like the blood circulatory system except that the fluid is clear and there is a heart to propel the blood.

The lymph is a clear fluid of essentially the same composition as blood plasma. This lymph circulates between the cells of the body and the capillaries of the blood vascular system.

The lymph vessels begin in the small spaces between the individual cells, unite to form larger channels and finally empty into the venous blood system by way of a large lymph vessel called the *thoracic duct.*

The lymph nodes are lenticular-shaped bodies occuring along the course of the larger lymph vessels. Where these nodes are present the lymph passes through the substance of the node and is filtered and purified. In case of infection these nodes usually become inflamed. They are of great aid in localizing and overcoming infections.

The Respiratory System. The term *respiration*, as commonly used, means the function of gaseous interchange between the blood and air taken into the lungs. This is really only a part of respiration and is *external respiration* as there is an exchange

going on all the time between the tissues of the body and the minute blood vessels, which is called *internal respiration.*

The air passages. Air reaches the lungs through the *nose, pharynx, larynx,* and *trachea.*

The nasal cavity. The nasal cavity is a fairly simple inlet and exit for the respiratory system. It consists of a passageway separated normally into two equal halves by the nasal septum. In the front portion, just inside the vestibule, we have a filter for the removal of gross dust and the prevention of entry of foreign objects such as insects. This filter is formed by the cilia of the cells lining the vestibule. Further protection is afforded by a reflex nervous action, in which foreign particles or irritants excite the act of sneezing. Within the nose, on the outer wall of each half we have three baffle plates with automatic thermostatic and hygroscopic control, the turbinate bodies. The space below the turbinates has openings which lead from the nasal passages to irregularly shaped recesses called the nasal accessory sinuses. The inner surfaces of the sinuses are lined by a moist membrane similar to that found in the nose. Below the lower baffle plate is the opening of the nasolacrimal duct through which tears are conveyed from the eye to the nose.

The pharynx. The pharynx is the large opening back of the cavity of the mouth. It is a common passageway for both food and air as it also communicates with the nasal passages. The pharynx continues downward as the larynx in front and a tube for food, the *esophagus,* in the rear.

At the root of the tongue there is a small triangular-shaped flap covering the opening into the larynx; when food is swallowed this flap closes and prevents food from entering the larynx. This flap is called the *epiglottis.*

The larynx. The larynx or "voice box" is that portion of the respiratory tract connecting the pharynx and the trachea. It is composed of nine cartilages, muscular and connective tissues. This organ contains two bands of tissue called the *vocal cords.* When the vocal cords are placed in a certain position and air is driven past them they are set in vibration and emit a certain sound. The strength of the blast of air determines the loud-

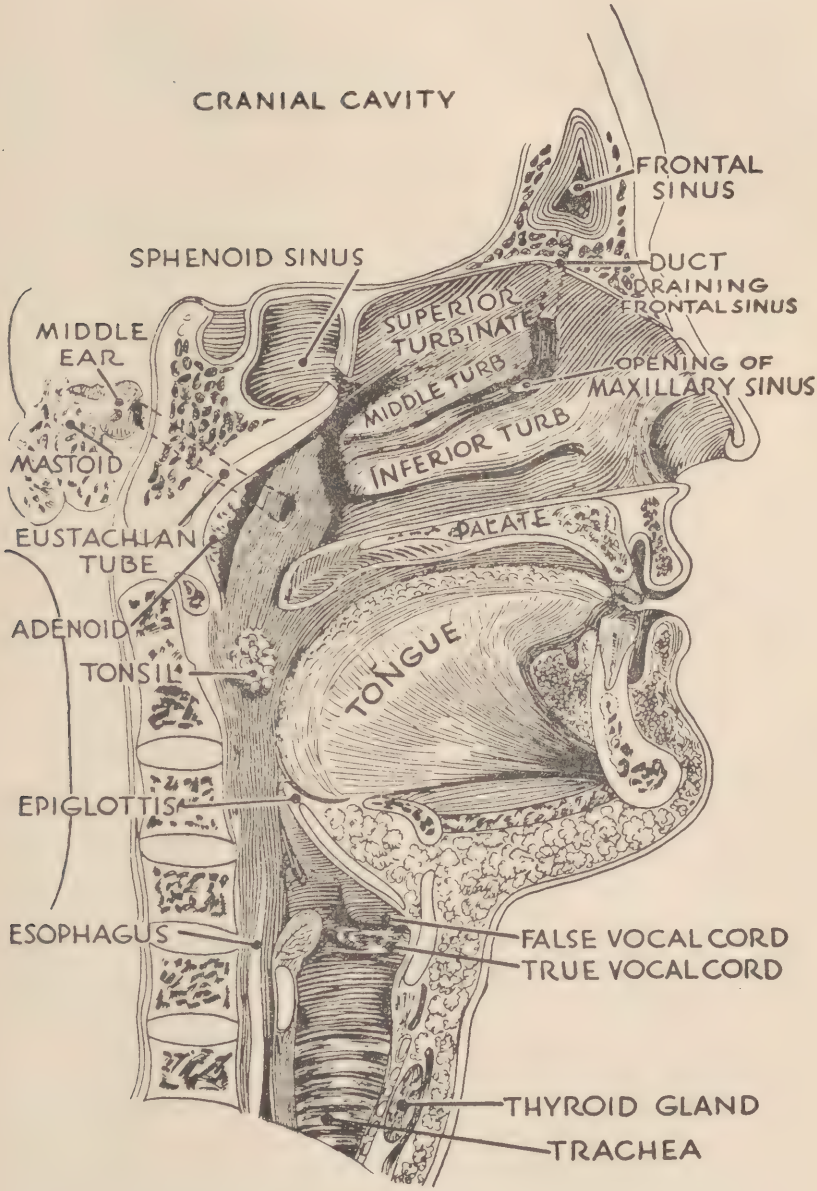

Fig. 3. Longitudinal section through nose, throat and mouth.

ness of the sound, the size of the larynx itself determining the pitch. In women and children the larynx being smaller than in men the pitch is higher. The sounds made by the vocal cords are strengthened by the resonance of the air in the pharynx and mouth and are altered by the movements of the tongue, cheeks, throat and lips into articulate speech.

The trachea, or windpipe, is a tube extending from the lower part of the larynx to the lungs. It is about four inches long and at its lower end divides into two parts, the *bronchi,* one of which goes to each lung. The trachea is composed of irregular rings of cartilage connected by supporting tissue.

The lungs are two in number, a right and left. Each has a bronchus connecting it with the trachea. These bronchi continue into the lung dividing and redividing until they end in a minute dilation or sac. As the bronchial tubes divide and redivide they become smaller and their walls become thinner until the smallest one as well as the terminal sacs or *alveoli* consist of but a single layer of cells. This single layer of cells is all that separates the inspired air from the very thin-walled capillaries surrounding them so that the diffusion of gases may take place readily.

The lungs are covered by a thin membrane, the *pleura* and not connected with any other tissue except at the *hilum* or root. The arteries, veins, and bronchi enter at the roots of the lungs.

The chest cavity or **thorax** is a cone-shaped cavity with the narrow end upward. It is surrounded on the outside by the ribs, breastbone and spinal column, the bottom being closed by the *diaphragm.* In addition to the lungs the thorax contains the heart, trachea and esophagus. The chest cavity is lined by the same kind of membrane that covers each lung, the *pleura.* In fact the membrane covering the lung folds back on itself to line the chest wall so that between the lung and the chest wall it forms a sac called the *pleural cavity.*

The mechanism of respiration. We breathe for two principal purposes. The first of these is to take in oxygen from the atmospheric air and make it available to the body tissues, where it is needed for the production of heat and energy, and for all the vital processes. The second of these purposes is to

rid the body of carbon dioxide which is a gaseous waste product of the body metabolism. The exact processes by which this dual function is carried out are as follows. Starting with inspiration, the chest walls and the contained lungs expand, causing from 400 to 800 cc. of atmospheric air to enter the respiratory tract (473 cc. = 1 pint). Not all of this inspired air reaches the terminal air sacs of the lungs, however, for about 150 cc. of it simply fills the upper air spaces such as the nose, throat, and trachea. The portion of the inspired air which does reach the lung air sacs is quickly mixed with the gases already present there and is further altered in composition due to the fact that oxygen is continuously leaving the lungs to enter the blood, and carbon dioxide is being given off from the blood to the lungs. This loss of oxygen and gain of carbon dioxide causes the composition of the lung air to differ considerably from atmospheric air. On the average, the former will be found to contain 14.5 per cent oxygen, 5.5 per cent carbon dioxide and 80 per cent nitrogen as compared to 21 per cent oxygen, 0.04 per cent carbon dioxide and 79 per cent nitrogen in the latter. The air in the lungs is known as *alveolar air* since it occupies what is technically known as the *alveoli* of the lungs.

The total pressure on the inside and outside of the body being always equal, the total pressure of the gases in the lungs at sea level must be 760 mm. of mercury. In the lungs the quantity of water vapor is considerable for it exerts a constant partial pressure of 47 mm.Hg. and makes up at sea level, about 6 per cent of the gases in the lungs. Therefore, to calculate the partial pressure of any of the atmospheric gases in the alveolar air it is first necessary to subtract that of the water vapor from the total pressure which, at sea level, is 760 — 47 = 713 mm.Hg. Since the alveolar air contains 14.5 per cent oxygen, the partial pressure of the oxygen is .145 x 713 = 103 mm.Hg., which represents the force which tends to drive the oxygen through the lung alveoli into the blood.

When the oxygen is driven into the blood under this normal pressure of 103 mm.Hg. it combines with the hemoglobin

of the red blood cells in an amount equal to about 96 percent of the blood's oxygen carrying capacity. That is, this pressure, almost, but not quite, loads the blood completely with oxygen. As the arterial blood enters the capillaries its oxygen pressure is still what it was when it left the lungs, while the oxygen pressure in the surrounding tissues is low, amounting to only a few millimeters of mercury. As a consequence of this pressure difference, the oxygen in the blood is driven through the capillary walls and flows into the area of low pressure in and about the body cells.

At this point, the partial pressure of carbon dioxide is higher in the tissues than in the capillaries, and the carbon dioxide accordingly flows from the tissues where it is formed, into the blood stream. Thus it is that blood returning to the lungs is low in oxygen and high in carbon dioxide. As this blood passes through the lungs, the carbon dioxide is given off to the lung alveoli and the oxygen supply is replenished. The final step in this cycle is the act of expiration during which the accumulated carbon dioxide is exhaled from the lungs.

The principal regulator of respiration is the amount of carbon dioxide in the lungs and in the blood. Whenever one does physical work, or exercises, a greater amount of carbon dioxide than normal is formed in the body and enters the blood stream. The instant the amount of carbon dioxide in the blood rises above its normal value the respiratory regulating center in the brain is stimulated and the breathing becomes deeper and faster in order to rid the body of this excess. Conversely, a decrease of carbon dioxide in the body decreases respiration. On the other hand, an increase of oxygen in the body has no effect on respiration and a decrease of oxygen increase respiration but slightly.

The Digestive System is made up of the alimentary canal and various organs or glands attached to it. The function of this system is to prepare food so that it can be used by the various parts of the body.

Foods. In order to provide energy for the body and to maintain and repair the tissues it is necessary to furnish material which can be made available for this purpose. Food stuffs

are usually classified as being *carbohydrate, fat* or *protein.* In addition to these the body requires water, certain inorganic salts, and certain food principles which are known as *vitamins.*

Proteins are required to replace worn-out tissue. They also furnish much of the fuel supply of the body. Meat, eggs, cheese, and beans are all rich in proteins.

Carbohydrates are oxidized in the body to give it energy to carry on its work. They are mostly of vegetable origin. Certain foods such as flour, sugar, and rice are examples of food rich in carbohydrates.

Fats may be of animal origin as in butter or may occur in vegetables as in olives. They act very much like the carbohydrates in furnishing energy to the body machine.

Composition of foods. Most foods contain more than one nutriment. Milk, for instance, contains two proteins, several fats and a carbohydrate. In addition there are several salts and vitamins.

Enzymes. Food to be used by the body must be reduced from a complex substance to more simple compounds. This reduction is carried on by means of substances called *enzymes* There are enzymes for the various types of food; they split carbohydrates into simple sugars, fats into fatty acid and glycerine and proteins into acids. These enzymes are present in the various secretions of the alimentary canal, each secretion having its specific enzyme. Some of the secretions contain more than one enzyme.

Absorption. After the food has been acted upon by the digestive juices it must be taken to the various tissues of the body in order to supply them with nutritive material. The transfer of food from the alimentary canal to the circulatory system is called *absorption.* This takes place almost entirely in the small intestine.

The simple food compounds are taken up by the receptive cells of the small intestine and pass either directly into the blood stream, or into lymph vessels which later discharge them directly into the blood stream. As the blood itself comes in contact with very few tissue cells there has to be some way of getting food to these cells. This is done by a process called *diffusion* which

goes on between the blood in the capillaries and the lymph outside. This same interchange goes on between the tissue cells and the lymph. The interchange of fluid is governed by *osmotic pressure.*

Metabolism is that process by means of which foods are broken down and rebuilt into living tissue.

The **mouth** is the first organ taking part in the preparation of food for absorption. The food after it is taken into the mouth is broken apart by the teeth in the act of chewing and is mixed with a substance called *saliva.* This is secreted by a group of glands located inside of the cheeks, under the tongue and under the lower jaw. Saliva contains an enzyme (*ptyalin*) which acts on starches to reduce them to maltose. After the food becomes semi-liquid it is swallowed and passes down the *esophagus* or gullet to the *stomach.*

The **stomach** is a muscular sac-like organ which lies just below the diaphragm and is lined with cells which secrete the *gastric juice.* This juice is an acid liquid which contains pepsin, an ezyme acting on the proteins to break them up into simpler compounds. At either end of the stomach there are rings of muscular tissue which, when contracted, close the openings and keep the food in the organ until gastric digestion has been completed. When this has occurred the muscle fibers in the wall of the stomach contract and force the food into the *small intestine.*

The small intestine is a long tube (about 22 feet) which lies coiled up in the abdominal cavity. It is in this organ that digestion is completed and from which the food is absorbed.

There is a small opening in the small intestine which receives juice from the *pancreas* and *bile* from the *liver.* These two organs are very important accessory glands of digestion. The pancreas which secretes *pancreatic juice* is a long narrow gland located back of the stomach. This juice carries on the work of breaking down the proteins and starches already started in the stomach and in addition acts on the fats.

The liver is the largest gland in the body and lies on the right side of the abdomen just beneath the diaphragm. Bile is formed by the liver cells and is collected in ducts which unite to form the one opening into the intestine. Some of the bile is by-

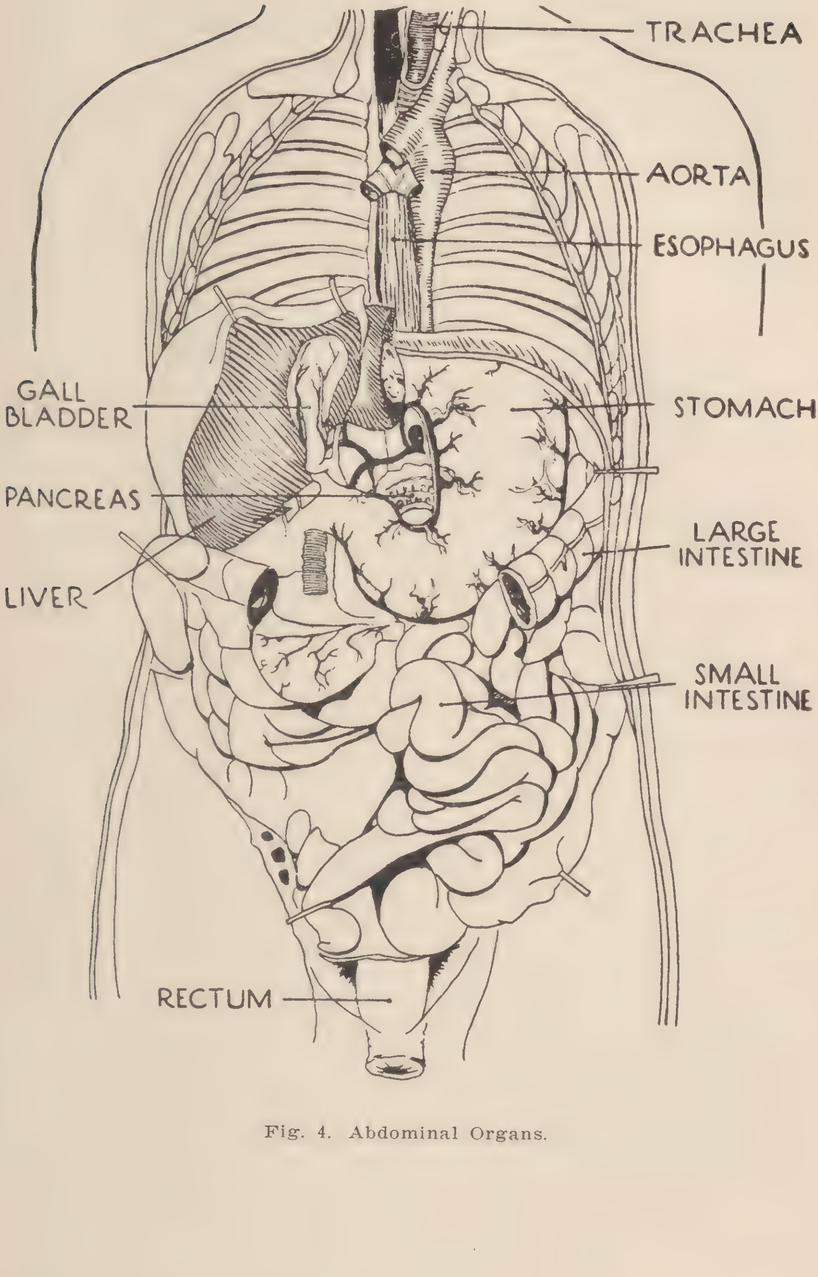

Fig. 4. Abdominal Organs.

passed up a small duct to a sac called the gall bladder. Here it is stored for future use. Bile does not contain any specific enzyme used in digestion but it does aid the action of the pancreatic juice especially in its action on fats.

Certain cells of the small intestine secrete the last digestive juice to come into contact with the food. This *intestinal juice* completes the breaking down of the proteins and starches.

The large intestine or colon is between three and four feet long and is much larger in diameter than the small intestine. It starts in the right lower part of the abdomen where the small intestine empties into it, extends upward to the undersurface of the liver, then across the upper abdomen, and down the left side to end in the anus.

Most of the nutritive matter from the food has been absorbed in the small intestine but the contents discharged into the colon are very liquid and as these are churned around whatever remains of value is absorbed together with much of the water content. The material remaining consists of undigested substances, bacteria and some waste products which collect in the lower part of the colon and are passed as fecal material.

The Excretory System. Waste material of the body is gotten rid of through the skin, lungs, urinary system, as well as the large intestine. The liver also acts as an excretory organ as it separates waste material from the blood and also changes certain harmful excretory substances into harmless ones and returns them to the blood for excretion through the skin and in the urine.

The skin in addition to being a protective covering, acts as an excretory organ. Skin consists of two layers, the *cuticle* or *epidermis* and the *true skin*. Located in the true skin are many very small glands, the sweat glands. These glands secrete the sweat which varies greatly in amount depending upon the environmental temperature, activity of the individual and certain other conditions. Sweat contains a certain amount of waste products similar to some contained in the *urine*.

The Urinary System consists of the kidneys, ureters, bladder and urethra.

The **kidneys** are two in number each one lying on the side of the spinal column in the back of the abdomen. They are bean-shaped organs between four and five inches in length and on the concave side of each is a notch called the *hilum*. Here the large blood vessels enter and leave the organ and the tube (*ureter*) which takes away the urine has its origin.

The blood enters the kidneys and when it has reached the fine capillaries the cells of the gland remove the impurities which pass into the ureters as urine.

The ureters are small tubes which carry the urine from the kidneys to the bladder. There is one ureter for each kidney.

The bladder is a hollow muscular organ lying low in the body just behind the pelvic bone. A ureter enters each side of the organ and as the kidneys secrete the urine it passes on to the bladder where it is stored, only having to be emptied at intervals.

The urethra is the tube through which the urine is discharged from the bladder.

The Nervous System is the most complex system of the body and may be thought of as two systems as the functions of one differ from the other. The *cerebro-spinal* system is that part made up of the brain and spinal cord and the nerves given off by these organs, namely, forty-three of cranial and spinal nerves. The other system is called the *sympathetic nervous system* and consists of two rows of central ganglia (masses of nerve cells) lying along the front of the spinal column, the ganglia being united with each other by strands of nerve fibers and connected by means of sympathetic nerves with various parts of the body. The sympathetic system has largely to do with the movement of involuntary muscles and the activities of glands.

The brain lies well protected in the skull. The organ consists of a large *cerebrum* and a much smaller *cerebellum*. The cerebrum is the seat of the mind. When it is removed all power of moving voluntary muscles is gone. Without it all sensations of light, taste, smell, touch and heat are lost. The cerebrum decides what we shall do. It sends out the messages to the muscles when we wish to move and is that part of the brain that thinks and feels. Without a cerebrum an animal can live but all of its

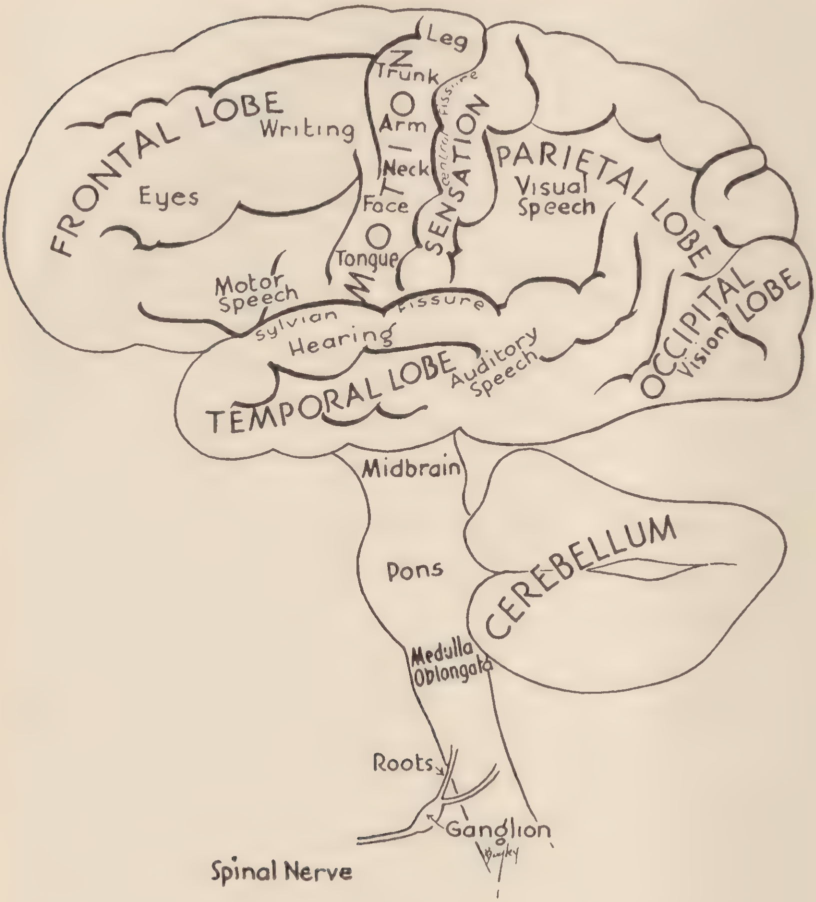

Fig 5 Diagrammatic illustration of lateral aspect of the brain

intelligence is gone. It still breathes but is only a machine.

The **cerebellum** causes all the muscles to keep the proper amount of contraction (*tonus*) and it assists in governing the muscles in standing and walking.

The **spinal cord** is a continuation of the nervous tissue extending from the brain down through the spinal canal.. The spinal cord widens out on its upper end where it is attached to the brain to form the *medulla oblongata.* The medulla is a very important part of the brain as it contains the nerve centers governing the action of the heart and respiration.

The spinal cord itself is a large bundle of nerve fibers which carry nervous impulses from the various parts of the body to the brain as well as impulses in the opposite direction.

Glands and Their Products. The fact that certain groups of tissue cells supply certain secretions to the body has been pointed out under the description of the alimentary tract. Some of these same glands also secrete substances which are absorbed directly into the blood stream. The pancreas, for example, not only secretes pancreatic juice but it secretes a substance directly into the blood which has to do with carbohydrate metabolism.

The endocrine glands is a term applied to these glands and the active substances contained in their secretions are called *hormones.* These hormones influence such functions as growth, reproduction, metabolism.

The thyroid gland, in the neck, one of the largest glands whose secretion is entirely an internal one, was one of the first to be studied from this view. Over-activity of this gland causes nervousness, loss of weight, rapid heart and other symptoms, while an insufficient amount of secretion, in children, causes mental dullness, retardation of growth of the long bones, coarse hair, etc.

The following glands secrete one or more hormones: Adrenals, ovaries, glands in the lining of the stomach and duodenum, testicles, pancreas, thyroid, parathyroid and pituitary. It is also believed that certain other glands secrete hormones but it has never been definitely proven.

The Special Senses. The special senses are feeling, tasting, smelling, hearing and seeing. These senses are due to the peculiar development of the ends of sensory nerves in various parts of the body.

The sense of feeling is more or less generally distributed over the body surface. However, in some places as the finger tips, the nerve endings are very close together and feeling is more acute. The sensory nerves of taste are all located in the mouth and those of smell in the nose. The other two special senses have rather complicated end organs which aid in the reception of either light or sound waves.

The eye may be likened to a small camera which is constantly photographing objects and sending the picture to the brain.

The eyes are well protected from injury by being placed in a hollow or socket in the front of the skull. On the exposed side they are protected by the eyelids, eyebrows and eyelashes.

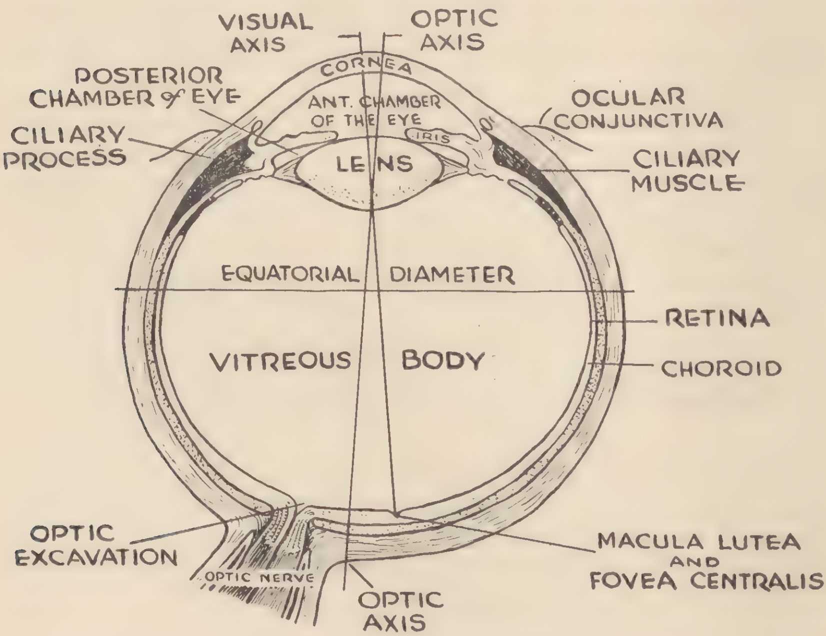

Fig. 6. Cross section of the eye.

The exposed surface of the eye and the inner surface of the lid are kept moist by the secretion of the tear glands .

The eyeball is generally spherical in shape being made up of two hollow segments of unequal size. The larger, posterior segment comprises about five-sixths of the eyeball and the anterior, one-sixth. These segments form two chambers, the larger containing a gelatinous material, the vitreous humor, and the smaller, the aqueous humor.

The eye has three coats, a thick outer protective one which is continuous with the clear *cornea* in front, but otherwise is thick and white; a middle coat which contains blood vessels, a small muscle, and in front the *iris*; and an inner coat which contains the end organs of sight of the optic nerve. This inner coat is called the *retina.*

The *lens* is placed right behind the pupil, being held in place by the *ciliary* muscle.

If the eye is compared with a camera it will be seen that rays of light entering the front of the eye through the pupil, pass through the lens and are registered on the retina which corresponds to the film. Now in taking pictures with a camera the operator has to regulate his light by means of a stop or diaphragm. This is done in the eye by the iris which produces a small aperture in bright light and a larger one in dull light. In a camera the lens is moved away from or toward the film in order that the light rays from the object to be photographed will fall on the film. This focus is changed depending upon the distance of the object from the camera. In the eye the focus is not changed by shortening or lenghtening the box, but by contraction and relaxation of the ciliary muscle the lens is made thicker or thinner as required.

Vision. The first phase in vision, in so far as the eye is concerned, is the formation on the retina of an image of a luminous object. The image is formed by the refractive actions of the cornea, aqueous humor, crystalline lens, and vitreous body. These structures are colorless and transparent. Their refractive indices are greater than that of air. The cornea and aqueous humor form a concavo-convex lens. The crystalline lens is bi-convex, the curvatures of its surfaces different and change-

able. The amount of light admitted to the eye is controlled by the action of the lids and of the iris. The eyes are directed toward an object being viewed by movement of the head and of the eyeballs themselves. The extrinsic muscles of the eye act to keep the principal axes of the two eyes parallel, or convergent or divergent as required. The combined effect of the refractive structures of the eye may be considered as that of a bi-convex lens, the posterior focal plane of which lies in the retina. Images of external objects are formed on the retina stimulating the sensory cells thereof. The sensation is conveyed to the visual tracts of the brain where perception takes place. Although the image formed on the retina is inverted this gives rise to no confusion as we have learned by experience to make proper interpretation of the sensation.

The production of a clear, distinct image on the retina is dependent, in the normal eye, upon the distance of the object from the optical center of the refractive system. When this distance is greater than 20 feet all light rays from each of the innumerable luminous points of the object are practically parallel and will be focused properly. As the distance decreases the rays will be divergent hence will not be focused. This difficulty is overcome by a change in the focal distance of the refractive system, a change which is produced by alteration of the curvature of the surfaces of the crystalline lens. This power of accommodation, as it is designated, is greatest in early life and decreases steadily with age. At ten years of age the normal eye can form a distinct image of an object 2¾ inches from the eye; by the fortieth year this distance has increased to about 8¾ inches and by the fiftieth year to 15¾ inches. Between the fortieth and fiftieth years, therefore, most people find it necessary to use convex lenses for near vision.

In the normal eye the optical center of the refractive system is 15.5 mm. from the retina. In many individuals the distance is either greater or less than this. When such is the case a distinct image is not formed on the retina. In the myopic (short sighted) eye the antero-posterior diameter of the eyeball is greater than normal, or the curvature of the cornea, or lens, too great. Lengthening of the eyeball is the more common case. Rays of

light are focused before reaching the retina and the retinal image is indistinct as a consequence. Myopia may be congenital or acquired; usually it is acquired. The defect may be produced by the increase in tension within the eyeball which results when the eyes are much converged, as for example, in reading with the book too near the eyes, a thing which is often done when the illumination is poor. If the fibrous coat of the eyeball be weak the increased tension tends to produce elongation of the antero- posterior diameter.

In the hypermetropic (far sighted) eye the focal point of the refractive system is beyond the retina and the retinal image is diffuse. The condition may be due to lessened curvature of the cornea or lens but is generally the result of a diminished antero-posterior diameter of the eye-ball. In most instances the defect is congenital.

Astigmatism is a common optical defect. In the so-called normal eye the refractive surfaces are sections of true spheres; all the meridians of the cornea are of equal curvature, the same being true of the anterior and posterior surfaces of the crystalline lens. In this event refraction is equal at all meridians. But if there is variation in the meridional curvature of any of the surfaces it can be seen refraction will be unequal, producing inequalities of the focal lengths in different planes. This is the case in astigmatism.

The ear consists of an external, a middle, and an inner ear. The external ear is ovoid in shape, flattened, wider above than below, and presents several depressions and eminences. This organ collects the sound waves and directs them through the external auditory canal to the middle ear. The external auditory canal is a tube about an inch long, slightly curved and lined with skin containing a few hairs. In the skin of the canal are a few glands which secrete a waxy substance which, together with the hairs, serves to prevent the entrance of foreign particles. The canal ends with the *ear drum* which separates it from the middle ear.

The middle ear is a small irregular air filled bony cavity in the temporal bone. The ear drum separates it from the external ear. A thin bony wall in which are located two small

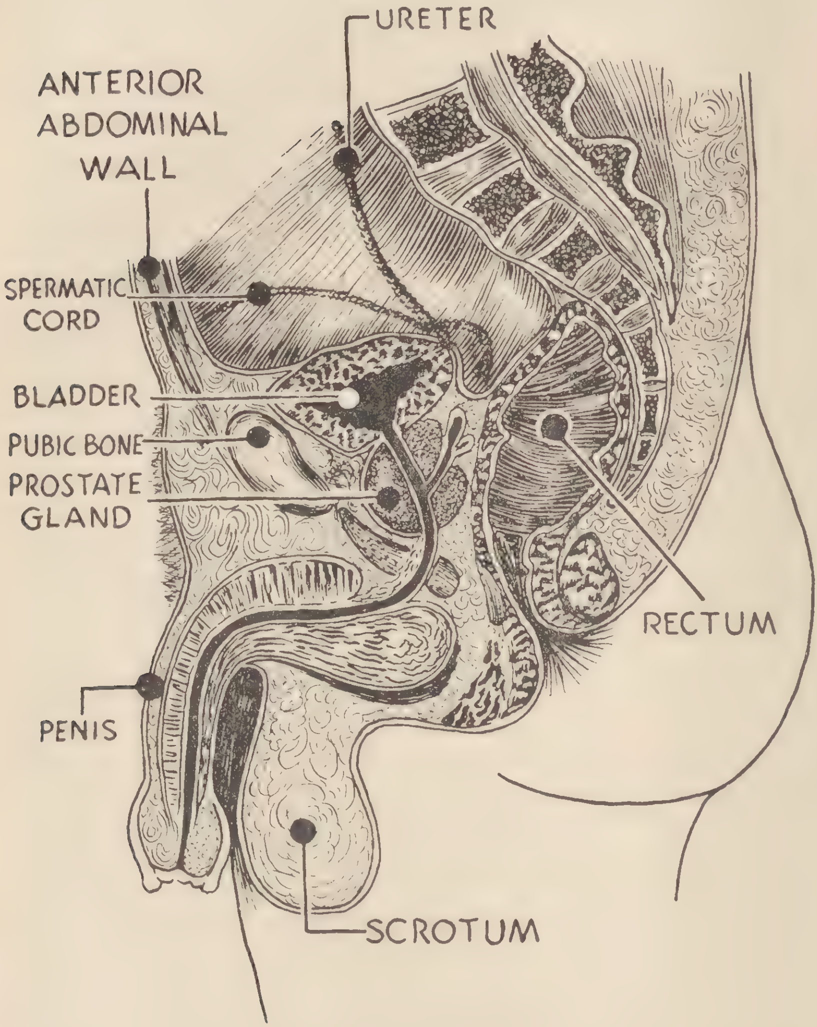

Fig. 7. The male genital system.

openings separates it from the inner ear. Stretched across the cavity of the middle ear from the ear drum to one of the small openings to the inner ear are three small movable bones called the *malleus* or hammer, the *incus* or anvil, and the *stapes* or stirrup. The eustachian or auditory tube connects the cavity of

the middle ear with the throat. In this way the air pressure on both sides of the drum is kept the same. When there is a change in barometric pressure on the outside of the drum, due to a change in altitude, this change is also present in the throat, after swallowing, and is transmitted to the middle ear. The eustachean tube is normally closed except during the act of swallowing or other similar physiologic acts. When due to any reason this tube cannot be readily opened, usually because of infection, there is no way of allowing pressure in the middle ear to change along with pressure on the outside of the drum. This will lead to discomfort or pain and possibly damage to the ear drum with temporary or permanent loss of hearing.

The internal ear contains the perceptive organ of hearing and consists of a bony labyrinth lined with a membrane and containing a fluid called endolymph. It is divided into the vestibule, the semi-circular canals, and the cochlea. The semi-circular canals and vestibule receive nerve endings from the auditory nerve and have to do with the sensation of equilibrium. The end organs of hearing are located in the cochlea.

The mechanism of hearing. Hearing is accomplished by sound waves which strike against the ear drum and are transmitted by the ear ossicles to the endolymph of the internal ear, the movement of which stimulates the end organs of hearing.

The functions of the ear. The ear possesses two different functions, that of hearing and of equilibration. The vestibular apparatus having to do with equilibration is adequate and effective under normal circumstances but falls down entirely under the bewildering difficulties of blind flying. In these situations it fails to properly orient the pilot in space and invariably gives false sensations leading to disorientation. Under such conditions the pilot must not trust his senses but instead rely entirely on his instruments.

Male Genital System. The *testicle* is the reproductive organ of the male, however, the vas deferens, seminal vesicles, prostate gland and penis are considered as accessory organs of reproduction.

The testicles are two ovoid glands which lie in a pouch of skin called the *scrotum.* They are covered with a thin membrane which doubles back on itself to line the scrotum. Before birth the testicles develop in the abdominal cavity and descend into the scrotum, usually, just before birth. The passageway closes up in most cases but sometimes remains open or at least weak so that the intestine may descend along it causing a *hernia* or *rupture.*

The testicles have two important functions, the first being the formation of the male cells or *spermatozoa* and the secretion of a substance necessary for the development of sexual characteristics in the male.

When the spermatozoa are formed they pass into a long convoluted tubule on the back of the testicle called the *epididymis.* This tube measures about 20 feet in length but is coiled up so that it takes up but little space. The tube of the epididymis is continued in a more or less direct manner as the *vas deferens* to a membranous pouch (one on each side) lying between the base of the bladder and the rectum. These are called the *seminal vesicles.* The seminal vesicles act as a reservoir for the spermatozoa and discharge them through small ducts into the back part of the *urethra.* At the same place where these ducts empty the *prostate gland* empties a secretion which is added to the spermatozoa.

The prostate gland is shaped somewhat like a chestnut and and surrounds the urethra just as it leaves the bladder.

CHAPTER III.

PHYSIOLOGY OF MILITARY AVIATION

The sense of flight. When man begins to fly he has to develop a new special sense, the sense of flight. This new sense gives him the ability to react to the invisible movements of the atmosphere, to feel or sense conditions of the air and movements of the craft in flight and to react properly with precise muscular responses. It is a composite sensation. It includes the feel of the seat, the feel of the controls, the action of the semi-circular canals and vestibule of the ear and visual, muscular and visceral sensations.

The trained pilot responds reflexly to the sensations of this new faculty. In this way he is able to anticipate movements of his craft and by coordinated control, he compensates and corrects.

Vision. Vision is the proper appreciation of light, of form, of color, of distance, and depth and all of these are of vital importance to the aviator.

Visual perception depends on the projection of an image upon the retina. This is a function of the cornea, lens and the fluid media. The amount of light allowed into the visual system and the focusing of objects onto the retina are governed by the minute muscles of the iris, the intrinsic muscles of the eye. With normal functioning of these parts, good visual acuity is accomplished. When there is a defect in the lens or the muscles controlling the lens, there is a reduction of visual acuity. Any reduction seriously impairs pilot efficiency. Images appear blurred and indistinct. As an example, the pilot with 20/50ths vision has to descend to 2,000 feet to see clearly objects that a person with a normal 20/20ths vision can see at 5,000 feet.

The eyeball is held in place in its socket and moved about by a series of muscles called the extrinsic muscles of the eye. When the fine balance between these series of muscles is disturbed, both eyeballs do not focus on the same object at the same time. Two

images impinge on the brain, which has learned to disregard one. This condition is called squint. In some cases where there is some lesser imbalance, that brain center which is responsible for merging the separate images from each eye keeps both of them in line. This leads to undue strain, and when an individual is under the influence of alcohol or excessive fatigue, this imbalance gets out of hand and double vision results. It is possible to test such latent muscle weakness by abolishing the influence of this center of fusion and noting when the eyeballs drift under the sole influence of the muscles themselves.

Depth Perception. A very important attribute of the visual apparatus is its depth perception ability. Depth perception may be defined as the ability to appreciate or discriminate the third dimension, to judge distance, and to orient oneself in relation to other objects within the visual field. Proper depth perception depends in great part upon the resolution by the brain of two images, one from each eye, taken from slightly different angles. For adequate depth perception it is necessary for both eyes to be functioning properly. This faculty is required to a high degree in aviation because upon it depends the ability of pilots to avoid obstacles, to land properly, and to fly in formation.

Color Perception. Color perception is a sensation which depends on the vibration rate and length of light waves striking the retina. Normal color vision exists only on that part of the retina intersected by the visual axis (the fovea centralis) and as the periphery of the eye is approached color vision is gradually lost. The term "color blind" is applied to those whose color perception is different from normal and in general more limited. It is usually a hereditary defect which almost always affects both eyes. The other ocular functions are not affected. It is estimated that 80 percent of the population have normal color vision, or to put it differently, they can distinguish six distinct bands of color in the spectrum (hexachromic). There are a few fortunate individuals (one in several thousand) especially favored by nature, who have a seven unit spectrum (heptachromic). The additional unit is described as an indigo. They also have a heightened perception throughout the whole spectrum.

The hexachromic or normal group may have a shortened spectrum. The shortening may occur either at the red or the violet end. If at the violet end of the spectrum the defect is of little or no practical importance; if at the red end, however, the individual may be in the dangerous color blind group. If a red signal light or rocket is viewed at a distance or through the obscurity of a thick fog or smoke it may appear green to the hexachromic with a shortened red. This is due to the fact that the red lights in common use contain not only red rays but green rays as well. Under conditions of obscurity the fog may blot out the few red rays that are capable of causing a sensation, while the green rays are perceived and give rise to the sensation green.

Seven to ten percent of all persons are pentachromic. The spectrum for them contains only red, yellow, green, blue and violet. They are unable to see the orange band. About 3 percent of all persons are in the tetrachromic group. Here the orange and blue are not seen. The spectrum contains red, yellow, green and violet. About 1½ percent of the population are trichromic. The spectrum is limited to the red, the green and the violet. The violet is often called blue. Approximately 2 percent of persons examined are dichromic. The dichromic spectrum is made up of dark yellow and blue gradually shading into one another. The true monochromic with a spectrum that contains only one color probably does not exist and he belongs for all practical purposes to the achromic or total color blind class.

Total color blindness is very rare. The entire spectrum is devoid of any vestige of color. The more luminous portions appear gray, the less luminous dark gray or black. The external world is perceived in black and white and intermediate grays.

Military significance of color-blindness. The Air Corps officer must be able to recognize various luminous signals such as field boundary lights, obstruction lights, navigating lights and rocket signals. Distinctive colors are employed to signify various vital conditions and prompt comprehension of their portent is essential for efficient military flying. The aviator must be able to recognize varying conditions of terrain by their shades and colors in cases of forced landings. Rain, light fog, and cloudy

conditions, especially in the early morning or towards evening, render color discrimination from an altitude very difficult, even for the normal eye; for the individual with inadequate color discrimination, such conditions will prove hazardous and end in disaster. It has been found that individuals with defective color vision, even almost approaching the normal, when subjected to excitement or nervousness, frequently suffer a reduction in their color discrimination. Thus trichromics when subjected to excitement, find their color discrimination reduced to the dichromic state and are apt to mistake a red light for a green one or vice versa. Proper normally functioning eyes are, therefore, of the greater importance to the aviator.

Spatial Orientation. The prime faculties for space perception are vision, touch, hearing, and kinesthetic sensations, the latter being sensations of movements received from muscles, tendons and joints. Closely allied to the movements of the eye muscles and probably to the movements of all muscles of the body is the vestibular labyrinth, which constitutes part of each internal ear. It is concerned with the sensation of body weight and gravity and with the sensation of motion and direction of motion. It aids in preserving a state of bodily equilibrium.

A man upon the ground with normal sense organs and vestibular labyrinths in the erect position with his eyes open has little difficulty in orienting himself or maintaining his equilibrium. If he should reverse this attitude and view familiar objects while standing on his head, his visual impressions would be unfamiliar and the factors of distance, size and shape of these objects would seem erroneous. If this same subject were blindfolded his sensory impressions would become still more untrustworthy.

If a man on the ground is likely to form erroneous impressions due to a deviation from his usual attitude towards other objects in space, it is probable that the pilot, riding in a machine capable of all manner of evolutions, would be more easily subjected to false sense impressions.

The pilot relies principally for the determination of his correct spatial relationship upon vision, which in point of range and delicacy surpasses any other sense. It is the experience of

pilots that when vision is eliminated, as in fog or darkness, that they are not aware of their relative position to the earth, and that they may emerge from a cloud in a spin, upside down, or in some abnormal position. The pilot's auditory, tactile, and kenesthetic sensations are inadequate to give him proper spatal adjustment and his vestibular labyrinths, when vision is blocked, fail to maintain equilibrium and orientation. The pilot must learn to understand his own inadequacy and the superiority of his instruments over his senses.

Sensitiveness to motion. The undulatory and rotary motions of flying may cause dizziness, nausea, vomiting, pallor and sweating. This is called air sickness. The vestibular apparatus of the inner ear is the organ which is chiefly concerned.

Ordinary orientation, for the most part, is dependent upon the action of the vestibular apparatus and the visual apparatus. When the impressions received from them do not coincide, the resulting conflict causes air sickness. The individual in an airplane feels motion but sees no change in position. Over stimulation of the vestibular apparatus alone may cause this condition. For this reason. it is most likely to develop during acrobatics and flying in bumpy air. An individual with a sensitive vestibular apparatus is more prone to air sickness.

It long has been noted that pilots become ill more readily when flying as passengers. The reason for this is that they become oriented visually while piloting and there is less conflict between the two sets of impressions. By giving airplane crews and passengers a good view of the horizon or of fixed objects on the ground, they can keep track of their position in space and lessen the occurrence of air sickness.

Effect of altitude and atmospheric pressure changes. At sea level, the atmosphere is weighed down and compressed by a layer of air approximately 62 miles high and whose composition is known to be constant up to at least 72,000 feet altitude. In the upper air the atmosphere, relieved of the weight, becomes thin. The atmospheric pressure at sea level is 760 mm. of mercury and it decreases with altitude. This decrease of pressure is not constant per unit distance of ascent, however, but is greatest near the earth's surface. Thus at 10,000 feet, in the

United States, it is 522.6 mm. Hg; at 15,000 feet—428.8 mm. Hg.; at 20,000 feet—349.2 mm. Hg.; at 30,000 feet—225.6; at 40,000 feet—140.7; at 50,000 feet—87.3; at 63,000 feet—46.9. The boiling point at this pressure is so low that the blood of man will boil.

An important matter concerning the atmosphere with which the student must become familiar is Dalton's law, relating to the partial pressure of gases. Dalton's law states that in a mixture of gases each gas exerts a partial pressure equivalent to that which it would exert if it alone occupied the whole of the space occupied by the mixture. Let us apply this law to the atmospheric air.

The total atmospheric pressure at sea level is 760 mm. of Hg, and since the atmospheric air contains 21 per cent oxygen, the partial pressure of the oxygen is 21 per cent of 760 or 159 mm. of Hg. In like manner we find the partial pressure of nitrogen in the atmospheric air amounts to .79 (the per cent nitrogen) $\times$ 760 (the atmospheric pressure) $=$ 600.4 mm.

Since the percentage of oxygen in the atmosphere remains constant with ascent but the total pressure of the atmospheric air decreases, it is obvious that the partial pressure of oxygen must also decrease with ascent. The process of respiration under normal conditions is possible only because the partial pressure of the oxygen in the atmospheric air is high and drives the oxygen of the air through the lining membranes of the lungs into the blood. When the oxygen partial pressure falls, as it does at high altitude, then less oxygen is carried into the blood stream and the body tissues begin to suffer from lack of oxygen. This is not significant until the altitude between 8,000 and 12,000 feet is reached. Here the lack of oxygenated hemoglobin becomes significant and the use of oxygen in addition to that in the atmosphere is necessary.

This shift from a 21 per cent oxygen concentration to a higher one readily provides sufficient pressure of oxygen to adequately oxygenate the hemoglobin. Above 33,000 feet, however, even while breathing 100 per cent oxygen, the pressure of the oxygen in the lungs and the oxygen saturation of the blood steadily decreases and will finally reach zero at just above 50,000

feet. The reason for this is that at 50,300 feet water vapor and carbon dioxide completely fill the lungs since their partial pressure of 47 mm. Hg. and 39 mm. Hg. in the alveolar air, are constant at all altitudes and together equal the atmospheric pressure of 86 mm. Hg. at that altitude.

The symptoms resulting from flight at high altitudes, as a result of an inadequate supply of oxygen, is called altitude sickness. The insufficiency of oxygen is called oxygen lack, anoxia, or anoxemia. The first symptom noted is a change in respiration. At about 12,000 feet the depth of respiration is about doubled but the rate remains constant. Above 12,000 or 15,000 feet, definite signs of mental and physical impairment appear. Vision, hearing, muscular coordination and judgment are all affected. The flier becomes dangerous to himself and to those flying with him. Due to the effect upon the intellect and judgment, the pilot seldom realizes his inadequacy. Sometimes there is mental dullness and lethargy. In other cases, there is a feeling of well being, of euphoria, and increased activity. This latter state, in combination with impaired efficiency of body and intellect, may result in serious consequences. It may be noted that these symptoms are identical with those of acute alcoholism, and it is believed that they arise from the same source, namely, a deficiency of oxygen supply to the cells of the brain.

The altitude at which these symptoms appear varies in different people, also the severity of the symptoms; and the extent at any altitude is a function of the time spent at that alitude. This is quiet important, because at first, a 12,000 feet, symptoms are minimal, but after several hours intense fatigue results. Repeated flights at this height without oxygen may lead to marked impairment of efficiency.

Air Embolism. Oxygen lack is not the only change in the physiology of high altitude. An important consideration is the development of airoembolism, or, as it is called in divers, the bends. This is due to the formation of nitrogen bubbles in the blood and other body tissues at high altitudes. Normally, the blood, other body fluids, tissues, and fat are saturated with nitrogen from the air. The amount of nitrogen dissolved is a function of the partial pressure of the gas at sea level. When there is any

decrease in atmospheric pressure, the tissues become supersaturated with the gas. If the ascent is slow enough, the gas will gradually pass out through the blood and lungs. When, however, the supersaturation reaches more than double, the nitrogen is no longer held in solution and nitrogen bubbles form. At a very slow rate of climb, calculated about 78 feet per minute, the nitrogen will be eliminated rapidly enough so that the bubbles will not form. At the rate of climb usually used at present, that is, from 500 to 4,000 feet per minute, definite nitrogen bubbles develop at about 26,000 feet. However, up to 30,000 feet, attacks of aeroembolism are infrequent. Between 30,000 and 35,000 feet, however, aeroembolism is fairly frequent. The symptoms vary considerably, depending on whether the bubbles are in the spinal fluid and affect the brain, whether they are in the blood stream and cause stoppage of blood to any particular part, or form in the tissues themselves and cause pain and disability because of pressure. The treatment consists of either descent to lower altitudes or prophylaxis by washing out the nitrogen from the body by inhaling 100 per cent oxygen for from forty to sixty minutes before and during the ascent.

For both the problems of oxygen lack and aeroembolism, the remedy of flying at these altitudes under conditions of normal atmospheric pressure has been suggested and attempted. This may be done by use of a pressure suit or a pressure cabin. Both have been tried with some success. The pressure suit is too cumbersome but has been used. The pressure cabin is being used successfully, and its application to military aviation is being worked out at present.

Effect of Speed and Centrifugal Force. Speed, constant in rate and direction, has no other effect on the body than that of a terrific blast of air. A speed in excess of 425 miles per hour has been attained. While traveling at such a tremendous rate of speed the flier does not dare expose parts of his body to such terrific pressure. If he held out an arm it would probably be broken, or if he stood up in his cockpit his head would probably be snapped backward with such force that his neck would be broken. The real danger, however, is not from constant speed but from acceleration. Acceleration may be defined as a rate of

change of velocity. Velocity has two properties, speed and direction. Variation in either or both causes acceleration. When an airplane takes off in a straight line, its velocity increases, resulting in positive acceleration. When it stops, there is negative acceleration or deceleration. Acceleration also develops if the speed is constant and the direction changed. This occurs in pull-out from a dive or during turns. Accelerations act by subjecting the body to an abnormal force. This force is usually measured in terms of the force produced by gravity. This is referred to as "g." 1g is the force pulling a body to earth; 5g is five times that, and so on.

Although there is no difference in which manner the force is produced, the axis of the body through which it acts is of extreme importance. Transverse accelerations, acting perpendicular to the long axis of the body, occur most commonly in aviation during takeoffs and landings. Such accelerations present no problems except in catapult take-offs and crash landings.

Acceleration directed through the long axis of the body from head to foot are called positive accelerations. These accelerations are experienced in turns and during pull-outs from dives. The duration as well as the magnitude of the acceleration has an important bearing on its effect on the body. With a positive acceleration of 2gs, there is a sense of increased heaviness of body. At 5gs, there is usually a beginning disturbance of vision. From 5 to 6gs, in the average person, there is a temporary loss of vision during which everything turns black, producing the phenomenon known as "blacking out." Between 6 and 8gs, consciousness is lost. These disturbances last only as long as the acceleration persists and return to normal during level flight.

These physiological phenomena are caused by the centrifugal force acting on the blood stream. The large vessels of the body run generally in the long axis of the body. The force acting from head to foot tends to prevent the blood from flowing toward the head and hastens its flow in the opposite direction. Consequently the heart has difficulty pumping blood to the eyes and brain. In addition, the blood is pooled in the lower part of the body, making it unavailable for transport to the brain. The blood pressure falls and with it the oxygen supply to vital nervous centers of the

brain. This temporary anoxia causes the symptoms. The drop in blood pressure lags somewhat behind the accelerations and explains why "blacking out" occurs at the end and just after acrobatics, rather than at the peak. A great deal of attention has been paid to the prevention of this phenomenon without too much success. Tight abdominal belts, to prevent pooling of blood in the abdomen, have been tried, with only fair results. Tilting seats have also been attempted.

Negative acceleration, that is, force acting toward the brain, is also experienced at times. This occurs during certain acrobatics, such as outside loops. Here the retina becomes congested with blood and the so-called "redding out" occurs. Forces over 2gs in their direction may cause lasting mental confusion, and over 4 may result in ruptured blood vessels in the brain.

Effect of Cold. The average atmospheric temperature decreases with an increase in altitude, slowly near the earth, and more rapidly as the altitude increases. The temperature during the first mile drops 1° F. for every 540 feet of ascent; from 14,000 to 16,000 feet it drops 1° every 360 feet of ascent; from 23,000 to 39,500 and above, the temperature remains quite constant at approximately 62° below in summer and 71° below in winter.

These extreme changes in temperature call for bodily compensations of unusual degree and promptness. The fall of temperature stimulates body metabolism, thereby increasing the demand for oxygen. However, the available supply decreases as altitude increases.

Heat production is varied by increasing or decreasing physiological oxidation of food stuffs, such as carbohydrates, fats and proteins. It is voluntarily controlled to some extent by ingestion of food and by muscular exercise. Heat production, however, is mainly under involuntary control through special centers controlling muscular metabolism. Under the influence of extreme cold, increased oxidation occurs, which is augmented by muscular contractions (shivering).

Heat loss from the body is controlled mainly by reflex control through vasomotor nerves and nerves controlling perspiration. In extreme cold, the amount of blood brought to or in con-

tact with the skin, where it loses its heat by conduction and radiation to the outside air, is diminished; also, the amount of sweat poured out upon the skin is decreased, thus diminishing or stopping altogether loss by evaporation. The body is also augmented by the use of clothing, thus diminishing greatly the loss by evaporation and radiation.

Young men possess rapid and adequate reactions to cold, while older men, with less power of response, are far more sensitive to low temperatures.

Effect of Wind. In flying, the aviator passes from a state of comparative calm to a motion through space that has the effect of a gale. This terrific blast accentuates the cold. A breeze of 15 miles per hour at a temperature of 59° to 68° F. will increase metabolism 19 per cent. The increase in metabolism calls for an increase in oxygen demand. A strong wind causes irregularity in depth and rate of breathing, but generally lung ventilation is favored. As a result, the alveolar tension of carbon dioxide is decreased and that of oxygen increased in the lungs.

Influence of Light. Snow blindness and sunburn depend on the reflection of ultra violet rays from large areas of water, snow fields and desert areas. These short rays are absorbed by the cornea, conjunctiva and skin, and injure their respective protein constituents. Any radiation of a wavelength less than 295 microns will produce harmful effects. Sunburn may be prevented by the application of cold cream to the exposed portions of the body before flight. Snow blindness should be guarded against by wearing approved tinted goggles. The wearing of such goggles should be compulsary in flying over water, at flying fields where the terrain is covered with snow or where glaring sunlight predominates.

Fatigue. There is probably no activity in which man habitually engages that requires as fine a coordination between the body, the special senses and the brain as military aviation. The aviator must be at the physical peak of perfection. He must have nervous stability and be capable of quick and accurate judgment. Due to the excessive strain that pilots undergo, both physical and mental fatigue are an ever present threat. They

are threats because they lead to staleness, and the stale pilot is a poor pilot who is a danger to himself and his fellows. He always seems tired. He loses enthusiasm. His work deteriorates. He beccmes nervous, cannot sleep, has all sorts of stomach disorders, and is irritable.

Staleness in pilots is most often due to accumulative fatigue. The pilot does not get adequate rest but keeps on working and finally goes bad. Specifically, excessive flying, worry, poor physical condition, participation in certain types of exhausting flying, such as high altitude work, night operations, dive bombing, etc., all are important factors in staleness.

The emotional factors are of extreme importance in the production of chronic flying fatigue. The responsibilities of the pilot are great, and with the responsibilities is the mental burden. No normal person can fly without being affected by them. The amount of attention and sustained alertness required are great, and while always fatiguing in aviation, are markedly increased by the danger which may be the penalty for momentary relaxation. In addition, the passive apprehensiveness which is always present in every pilot takes its toll of nervous energy. This takes such a toll that it has been found pilots are good for only from 50 to 100 hours of combat flying before they showed loss of efficiency and had to be sent on leave to recover.

CHAPTER IV

PERSONAL HYGIENE.

Personal Hygiene. General. Hygiene is a branch of medical science pertaining to the preservation and improvement of health. Personal hygiene treats of the application of this science by the individual to the advancement of his bodily welfare. The subject is a very extensive one, including all agencies which affect the physical and mental well-being. The efficiency of an individual rests upon the formation of correct health habits. When these are established a cheerful confident individual is developed who has the strength, endurance, and capacity either to avoid or overcome the usual hazards of life.

The skeletal and muscular systems. Temporary or permanent impairment of the skeletal and muscular systems, resulting from disease, injury, and incorrect habits as to posture and exercise may and frequently do decrease mental and bodily vigor. Tuberculosis and syphilis attack all parts of the body; when they affect bone the damage is almost irreparable. Fractures differ greatly in severity. In many instances there is incomplete recovery of function in an extremity, a bone of which has been broken. When joints are involved in fractures, restoration to the normal seldom occurs. Compound fractures are always grave: they are often complicated by an osteomyelitis which destroys much of the bone. Fractures of the skull, spinal column and pelvis frequently result in death; in the great majority of those who survive permanent disability results. Crushing and tearing of muscular tissue may be followed by infections endangering life producing such loss of substance that the muscle can no longer function normally. To the extent that disease and mishap are preventable each person is the guardian of his own health and that of others. He should realize his responsibility in this connection and seek to eliminate all hazards to health and life.

Exercise. Exercise produces not only an increase in the amount of muscular tissue but it brings about other results which are of equal or greater value. During exercise there is increased activity in all the vital functions of the body. The heart rate is increased, respirations are deeper and more frequent, food is utilized more fully, and accumulations of waste are removed with greater facility. Waste materials may form more rapidly than they can be removed, in case the excercise is unsuited to the individual's capabilities or is prolonged. This leads to a feeling of weakness or to exhaustion. The condition is known as fatigue. Exercise which causes any degree of fatigue is to be avoided. The body can be trained by properly chosen, graded exercise to withstand great physical exertion without untoward effects. Growth and the shape and symmetry of the body may be favorably or unfavorably influenced by exercise.

The best exercise is that incidental to work or recreation. Exercise taken merely for its own sake is usually repugnant as it does not contain the element of interest. All forms of suitable, competitive sports are to be encouraged and an effort should be made to interest and include every individual in some type of recreational activity.

Posture. As the bones furnish support for the body and points for attachment of muscles, it is very important that the bony parts of the body be held in correct positions. Posture modifies many vital functions. A slouching attitude relaxes the abdominal muscles and allows the abdominal organs to change from their normal position, and thus to function poorly. Headache, lassitude, faulty digestion, and constipation are frequent sequelae of a slouching posture. Good posture almost produces a feeling of confidence and optimism. It portrays mental energy and alertness. Incorrect positions of the body in sitting, lying, walking, and standing affect health adversely.

In walking or standing, muscular and nervous weakness are indicated by rounded shoulders, relaxed abdomen, forward and upward thrust of the head, and the position of the arms (in front of a vertical line through the center of gravity of the

body). In walking, the body should be carried in the erect position with the weight on the outer side of the feet, the toes pointing directly forward. At a desk or table the common fault is that of sitting too far forward on the buttocks so that the back is rounded, shoulders hunched, and elbows stretched out. In the proper position the trunk is straight; bending occurs at the hip joint and not in the spine. In reclining, all muscles should relax. It is generally better to lie on the side than on the back. It is undesirable to elevate the head more than two inches.

Feet. In walking, the foot should be placed on the ground so that the line of direction is parallel to the line of movement, the heel should strike the ground first and then the weight should be carried forward along the outer border of the sole to the ball of the foot and the toes.

The bones of the foot are arranged to form a long arch on the longitudinal axis of the foot and a short, not well defined, transverse arch in the region of the ball of the foot. These arches are held in normal position by ligaments and muscles of the foot and leg. In the erect position the body weight is borne on the heel, the outer border of the sole, the inner and outer portions of the ball of the foot, and slightly on the balls of the toes. The line of weight bearing lies in a plane passing through the middle of the patella and popliteal space, the attachment of the Achilles tendon to the calcaneum, and the space between the great and second toes. The curvature of the arches, particularly that of the longitudinal arch, is subject to considerable variation. In the condition known as pes cavus or, hollow foot, the curvature of the longitudinal arch is much greater than normal; in pes planus or flat foot, it is much less. This anatomical variation in the arch may or may not interfere with normal functioning of the foot. When pes planus is due to weakness of the muscles and ligaments which support the arch, use of the foot in weight bearing is painful. In the more serious degrees of flat foot, referring to the clinical rather than the anatomical condition, the foot is rotated outward at the ankle. Flat foot probably is due to an inherent weakness of the muscles of the leg and foot. The wearing of shoes tends

to interfere with the efficiency of the muscles of the foot, and improperly fitted shoes are particularly harmful in this respect. The position of the feet at "attention" is physiologically abnormal. It is assumed in order to widen the base of support of the body, thus giving steadiness, but it tends to produce depression of the inner border of the foot. This position of the feet should not be held in walking or marching.

Rest. The ability to relax is one of the principal safeguards of health. Time for rest and relaxation should be planned for and used wisely. This one factor will determine, to a great extent, the ultimate success or failure of an individual. Rest may be found in play, change of occupation, working at a hobby, or in sleep. Play is a most valuable way to spend leisure hours as it furnishes pleasant activity for both body and mind. Everyone should retain or reestablish the habit and ability to play. During sleep all voluntary effort ceases, all vital activities are diminished, and the reparative processes of the body predominate; complete rest is obtained. Generally, a person should obey the impulse to sleep when sleepy but not try to sleep in excess of his natural desire. The amount necessary depends on the individual and the accumulated repair requirements of his body. Freedom from stimulation of all the senses is essential to sleep. The sleeping room should be quiet, darkened, devoid of unpleasant odors, and well ventilated. There is no virtue in large amounts of cold air, but cool air is soothing and moving air carries the respiratory products away. The mattress should be firm rather than soft. With relaxation of the muscles the usual support of the spinal column decreases so that on a soft mattress abnormal bending of the spine, productive of pain, takes place. One does not long remain immovable during sleep, probably because of the pressure on surfaces unaccustomed to pressure. The bed clothing should be sufficient to protect the body against undue loss of heat but not of such weight as to produce unpleasant pressure.

The nervous system. A healthy, mental attitude is an important hygienic requirement. It implies the ability on the part of the individual to live in harmony with his associ-

ates and with his physical environment. It can be attained by the normal mind through a process of mental training which must begin in infancy and be continuous.

Of all the emotions the one most commonly displayed is anger. Anyone who exhibits violent temper invariably stands to lose in two ways: first, disturbed bodily function, and, second, loss of personal prestige. Personal prestige is always lessened, as violent temper with consequent loss of mental poise denotes a weakness in character and personality. This is recognized by the person who resigns to his emotions, and inevitably leads to deep regret. A happy outlook on life should be encouraged not only to produce health but as an end in itself. Discontent and mental strife are often the consequence of wrong conditions in the body. When the oppressive cause is removed recovery may be complete or the discontent may remain in spite of cure and be attributed to something else.

Mental activity that is driven, anxious, or depressed, that is, burdened with remote fears and worries, is distinctly injurious to health of body and mind.

Worry. Worry is the most common form of abnormal mental activity. It usually arises from one of the following situations or conditions: (a) What we have done, (b) what we are going to do, (c) what people think of us, (d) our mental and physical health.

To worry over what has been done is obviously foolish, however, the stream of thought about the subject is there and can be eliminated only by substituting other thoughts or mental activity. One thought can be removed only by driving it out with another thought. To worry about what we are going to do is to reduce or destroy our power to accomplish the mission. The best procedure is to study the problem, make a prompt decision, and then substitute work on the task for the useless and harmful worry. Any person who only exists today to live at some future time will never know true happiness. To worry over personal criticisms is especially harmful. If the criticism is reasonable and just, begin to correct the condition immediately. If the criticism is foolish, forget it and become occupied with other things.

Worry over health or bodily functions often produces functional diseases. Where conditions actually are abnormal worry inevitably increases the disturbance. Strict discipline and training together with a substitution of new interests will always correct this condition.

Normal mental life. A healthy state of mind comes from satisfaction with life. It is recognized that a defective nervous system may be inherited; however, most defective mental make-ups are acquired through improper discipline and training. A correction of this condition is always possible. Any individual can so direct and order his life as to attain gradually a higher level of control than either training or heredity would have promised. To attain a higher level of control it is necessary to replace unwholesome conditions and habits by definite plans and purposes that will bring satisfaction to the individual. All that a healthy mental attitude implies can be summed up in the word "serenity". Everyone must learn through practice and discipline how to avoid or suppress the strong emotions such as fear, hate, jealously, and grief. The serene attitude is often disturbed or destroyed by trying to accomplish too much, in other words, trying to live many days in one. Thoroughness is more productive than speed. To hurry is to reduce effective production of work.

Open mindedness means the willingness to accept a new idea regardless of the established belief or custom. It makes for new relationships,.interests, meanings, variety, and health.

Unselfishness produces satisfaction, confidence, and belief in oneself. It is necessary for a full breadth of vision. Confidence and the sense of value of one's own person is the foundation for most accomplishments. It can be developed by applying constant effort to each task until success is experienced.

All of our activity and ambitions should be guided by reasonable intelligence so that tasks suited to the individual are selected. The simple life, the commonplace every day affairs of work and play make for health and happiness. The sensational, exotic or bizarre course should be avoided.

The blood-vascular system. In order for the heart to per-

form its function as a pump the valves must close tightly and the muscle be strong enough to propel the blood through the arteries.

The heart valves are most frequently injured by common diseases. Those usually responsible are rheumatism, scarlet fever, tonsillitis, and syphilis. Infected teeth are also an important factor as they are often the portal of entry for organisms that cause rheumatism. The heart muscle is supplied with blood and reacts to disease, exercise, or fatigue exactly as do other muscles of the body. Avoidance of the common communicable diseases, over-fatigue, throat infections, and bad teeth will prevent most heart trouble. To keep the heart in good condition it is necessary to preserve good health. Where the heart is normal and the body free from infection, exercise can be engaged in at will. Athlete's heart, or heart injury due to excessive, hard exercise, is not so frequent as is generally supposed.

The loss of elasticity in arteries, known as arteriosclerosis, is caused by poisons from infections or may be due to inefficient elimination of waste substances. Prevention of excess body wastes embraces all of the principles of hygiene. Correct diet and eating habits, regular bowel function, and physical exercise are of particular value. Here again it must be remembered that good posture, clear skin, and a cheerful contented expression are real evidences of health. To avoid the effects of overwork it is necessary to lead a temperate life in all things, especially while at work or play and when eating or drinking.

Veins carry blood back to the heart. The return flow is made possible by muscular activity and the small valves in the walls of the veins. It must be remembered that activity is necessary for this return flow and that any obstruction by garters, belts, or tight clothing impedes the circulation and tends to dilate the walls of the veins. When veins become dilated and tortuous they are called varicose veins.

The digestive system. The proper selection of food, correct eating habits, and final elimination of intestinal wastes are fundamental hygienic factors.

A knowledge of the function of foods is necessary for the selection of a proper diet. The requirements of the body are related to the amount of work done. To maintain the body, food must be taken in sufficient amounts to cover the needs. If an excess is taken fat is stored; where the diet is insufficient the body burns its own tissues. It is not desirable to set absolute standards. The diet should cover the needs of the individual and be sufficient in caloric content for the amount of work done. Variety of food is conducive to a good appetite while a selection of the different classes of foods is essential for health.

Food fads are usually based on unscientific opinions or partial truths. Vegetarians would eliminate animal proteins in spite of the fact that the dominant races in the world are meat eaters. Raw food, sour milk, or hot water fads are based upon some individual's experience and would be dangerous if adopted as standards.

Overweight has an unfavorable influence on the length of life. After maturity it is better to be slightly under the normal or average weight. Drastic reduction methods are dangerous. A careful modification of the diet and supervision of exercise are all that ever should be attempted. The complete elimination of certain classes of foods should not be attempted, nor should reducing remedies be taken without the advice of a physician.

Correct eating. Digestion is better when the dining place is clean, attractive, and quiet. Noise is not compatible with good digestion. Anxiety and mental strain will delay gastric digestion. One should come to the table rested and free from excitement.

Food should be well chewed. If this is done it will not be necessary to wash it down the throat with large amounts of water. It is better to drink the necessary amount of water between meals.

Regular evacuation. The habit of emptying the bowels daily at a regular time should be developed. The best time, physiologically and usually as far as a person's time is concerned, is immediately after breakfast. Once the habit is established it should be rigidly followed.

The principal causes of constipation in the absence of disease are improper posture, lack of exercise, poor diet and eating habits, and the use of cathartics and laxatives. All drugs such as cathartics and purgatives are not only harmful but unnecessary to the healthy individual.

The skin. The common everyday method of judging an individual's health is by the appearance of his skin, by his facial expression, and by the way he walks or sits. We are accustomed to judge health by looks, for we have found that the outward appearance is suggestive of the internal health. All body vitality comes from within and cannot be applied from the outside. Skin tonics, foods, or bracers are of no value. There are very few drugs or preparations that will penetrate to the derma or true skin.

It is probably true that bathing is not absolutely essential to health; however, the modern conception of health is concerned not merely with freedom from disease but considers also the mental attitude and well-being of the person. The value of the shower following work or exercise lies not alone in the removal of dirt but also in the stimulating effect on the nervous system.

The warm bath (90° - 98°F.) is not only cleansing but is also relaxing to the individual and conducive to rest and sleep. The cold bath (under 65°F) is very stimulating, especially so if a shower bath is used. The shower is more beneficial, for it massages the skin and is more sanitary than the tub bath. When a tub or shower is not available a cold sponge bath followed by vigorous massage of the body with a coarse towel is beneficial. Hot baths (above 98°F.) should be used only when prescribed by a physician.

The value of sea bathing is not derived from the salt in the water, since salt cannot be absorbed through the skin. The real value of all outdoor bathing lies in the exercise obtained in the play and sport and in the exposure to sunshine. The sun bath is becoming more popular and unquestionably does have beneficial effects if not prolonged. The exposure to sun rays should be brief and very gradually increased; otherwise sunstroke may occur.

The head obviously should be washed whenever the hair and scalp are dirty. Usually this is not necessary more than once a week, while for some people two or three weeks intervals are allowable. Vigorous shampooing of the scalp with plenty of soap and water is all that is necessary. The much advertised products and processes or methods for improving the hair have no special virtue. Hair tonics are of very doubtful value. Hair removers, dyes, and preparations to stop perspiration should be used cautiously. Many of these are poisonous.

Clothing. Clothing must fulfill two demands: first, it must conserve or allow dissipation of body heat, and second, it must absorb moisture from the body.

To conserve heat, or in other words protect the body against cold, clothing material must be of such a nature that the fine meshes in the weave will hold air. Wool is valuable in clothing because the wool fibers produce innumerable small interstices in the mesh and serve to insulate the body by providing many small dead air spaces. Fur is valuable because of this peculiarity; it is said to contain 97 per cent air and only 3 per cent fur. Cotton cloth does not possess the fine mesh of fibres and so allows for nearly a direct circulation of air with little or no insulation of the body. Clothing for hot weather must permit circulation of air and also absorb moisture. When moisture collects on the body evaporation is retarded. This means that the process of cooling the body is greatly interfered with. It is also essential that no moisture collect on the body in cold weather since heat is rapidly lost through conduction by moisture, and rapid chilling of the body may occur. For outdoor work in cold weather, woolens should be worn next to the skin, for they are absorbent and prevent rapid evaporation. In summer, cotton clothing is ideal. Color of clothing is important since light colors absorb but few of the heat rays. Dark colors are warmer and, too, the dyes used for coloring may cause skin disturbances. Underclothing is necessary to protect the outer garments from perspiration and to furnish a layer of clothing that can be washed readily. All underclothing and socks should be changed daily. If this is not possible they should be well aired and dried at night.

All constrictions caused by clothing should be prevented if the greatest body comfort and efficiency is to be obtained. Suspenders should be worn when possible. Tight waist belts and garters impede the blood flow in the veins of the skin. Collars should not interfere with the blood vessels of the neck. A tight collar may cause headaches.

For operations in extreme cold considerable attention must be given to clothing. A space of dry air next to the body is needed to keep the heat in. Consequently, inner clothing should be of a loose, spongy weave, flexible and porous enough to hold a thick insulating layer of dead air. Outer clothing should be of a texture that will act as a windbreak and inclose the warm air in the inner clothing. It should be loose and sufficiently porous to prevent the moisture of perspiration from condensing and freezing on the inner surface.

Several layers of light clothing are very much warmer than a single layer of equal weight. Underclothing should be of pure wool with separate undershirt and long drawers. For cold weather operations the usual pattern of overcoat allows too much escape of air and the turned-up high collar collects snow like a funnel. An outer coat on the style of a parka should be worn. The ordinary military breeches are too tight at the knee to allow for proper circulation. Light windproof and water repellent cloth over porous wool is a good combination for trousers. Hard finished, closely woven gabardine is also an excellent material for use in extreme cold. For horse cavalry, breeches which are loose fitting, especially at the knee, are suitable.

Tight shoes result in frozen feet. For temperatures of extreme cold, shoes, shoe pacs, or mukluks should be large enough ot contain two pairs of light wool socks, a pair of heavy knitted wool socks, a burlap boot sock and an insole of felt or preferably of burlap. Too much emphasis cannot be placed upon the importance of having the shoe fit loosely.

To protect the hands, a loosely woven woolen mitten extending well above the wrist is worn next to the hand. The mitten should provide a compartment for the thumb, for the trigger finger and for the other fingers including the trigger

finger when not in use. The mitten may suitably constitute the inner lining of a gauntlet which is worn over the mitten in very cold weather. The wearer should be able to fire his personal weapon without removing the gauntlet.

To prevent snow blindness suitable pigmented glasses must be worn.

In desert operations, because of the wide temperature range and the cool nights, the summer uniform must be augmented by woolen garments for wear at night during the hot season. Woolen uniforms and some type of overcoat are necessary for winter operations in the desert as during this period the weather is extremely cold, raw and disagreeable. A woolen band should be worn over the stomach, particularly in the summer, to prevent stomach chills. The hotter the day the more necessary is this protection.

Sun helmets must be worn to protect the head and back of the neck from the sun's rays. In the tropics, helmets should be worn even while bathing. Other equipment which adds to comfort and efficiency in desert operations are goggles, sun glasses, respirators, neck cloths, nose cloths and fly switches. The Arabs, as a result of centuries of desert life, wear a cloth to protect the back of the neck from the sun's rays and a cloth over the nose to protect the lungs from sand and dust during storms. Sand flies are an ever-present pest in the desert and horse-tail fly switches are in almost universal use among troops as a protection against their bites.

Clothing selected for jungle service should have a minimum capacity for heat absorption and a maximum capacity for the circulation of air to permit the evaporation of perspiration from the body. The head must be protected from the rays of the sun by a hat which permits free circulation of air about the scalp and which is broad enough to protect the face and neck from the sun's rays.

The genito-urinary system. Since the kidneys are so closely associated with the blood, blood vessels, and heart the three are usually considered together. Physicians ordinarily look for disease in all of these structures if any one of them is involved. Hygienic principles that apply to the heart

and blood vessels generally apply to the kidney. In addition, it is necessary to consider the remainder of the urinary tract and genitals. Disease of these structures often affects the kidney.

Not infrequently gonorrhea causes stricture or obstruction in the urinary tract to such an extent that drainage is interfered with and in the presence of infection the entire system, including the kidneys, may be badly damaged. This same disease may involve the prostate and cause abscesses or else a very chronic infection that may persist for several months or even years, in spite of treatment. The same thing may happen to the seminal vesicles. Passing down the vas deferens the infection may cause an acute painful inflammation of the epididymis and testicle. Infection along the vas deferens or in the epididymis and testicle is a common cause of sterility. A characteristic of the disease is its chronicity. It may exist for years in a person apparently cured.

Syphilis begins as a local disease called the hard chancre. After three or four weeks it becomes a generalized disease and is disseminated by the blood to all parts of the body. The cure of this disease calls for the best care and judgment of a physician. To rely entirely on the usual blood test is dangerous. Repeated examinations, blood tests, and tests of the cerebro-spinal fluid should be made over a period of months or years, depending on the stage the disease was in at the time treatment began, before cure can be said to be positive. Self treatment or treatment on the advice of a druggist or a quack is not only valueless but dangerous.

Chancroid or soft chancre by itself is not to be feared; however, syphilis may be present in the same sore. All genital sores should be considered syphilitic until positively proved otherwise.

The respiratory system. Air should be taken in through the nose in order that dust and dirt be removed and the air moistened and warmed before passing to the lung tissue. The mouth should be regarded as only an emergency entrance for air.

The best exercises for lung development are the usual outdoor activities, games or sports such as hiking, running, or

climbing. The set breathing exercises of the home or gymnasium are of doubtful value. The defects for which breathing exercises are used are best corrected by physical exercises that not only increase respiratory action but also give the additional body-building effects. Cold bathing is a valuable measure for keeping the tone of the mucous membranes lining the respiratory tract in good condition.

Formerly the presence of organic poisons, body odors, and excessive carbon dioxide were believed to be responsible for the harmful effect of poor ventilation. However, it is now known that improper temperature and humidity and defective circulation of air are the real causes for the ill effects experienced.

Overcrowding is dangerous, not because there is insufficient fresh air, but because persons come within the coughing and sneezing range of each other. A great many of our diseases are spread by breathing the fine droplets containing infection that have been coughed or sneezed into the air by one suffering from a specific disease. All secretions coming from the nose or throat of one having a respiratory disease should be burned at once. The ordinary use of the handkerchief is a bad habit, for the individual is constantly reinfecting himself and contaminating his surroundings. Paper handkerchiefs that can be destroyed are the only proper means of disposing of the secretions of colds. Spitting is a disgusting and filthy habit. As the saliva dries, organisms of the nose, throat and mouth are carried into the air and are breathed in by other people or settle down and contaminate the surroundings.

The teeth, mouth and throat should be cleaned night and morning and, if possible, after each meal. Gentle pressure with the tooth brush well saturated with a soapy tooth paste, not containing polishing materials, is advisable. The brush should have bristles that are stiff and of different lengths so that all the crevices of the teeth will be reached. The direction of brushing should be up and down along the long axes of the teeth. The process should take five minutes .The gentle use of dental floss is beneficial. The tongue should then be scrubbed with soap and tooth brush. Washing the mouth

and throat should follow these procedures. Most prepared mouth washes are valueless as far as germ-killing powers are concerned since anything that will absolutely kill germs on contact will also injure the delicate membranes of the mouth. A pinch of salt and soda in warm water will clean the membranes which is all that is to be desired from any mouth wash. The pernicious habit of spraying or douching the nose and throat is condemned as useless and dangerous unless specifically prescribed by a physician. Any fluid entering the nose under pressure is apt to pass into the sinuses or middle ear and start infection.

The tonsils probably serve to protect the individual against respiratory diseases during childhood. However, when they become infected they are a frequent cause of sore throat. The important thing is that when infected they may eventually cause heart disease, rheumatism and other serious afflictions. The adenoids probably have a similar function during childhood and may also harbor dangerous infection. In addition, due to their location at the back of the nose and throat, they may form an obstruction to normal breathing which in turn may result in face and chest deformities, underweight, and nervousness. The removal of diseased tonsils and diseased or enlarged adenoids is a valuable procedure.

The common cold is an important condition not only from the standpoint of the disease itself and its possible complications but from the loss of time it entails and the deleterious effects of repeated colds. To avoid colds one must have a nose and throat free from chronic infection and obstruction. Indiscretions such as overeating, chilling the body, overwork, and loss of sleep are to be avoided. General defense against colds is dependent upon personal hygiene. The following are some of the more important rules:

1. Obtain sufficient sleep in a well ventilated room.

2. Avoid close, warm rooms where the air circulation is poor.

3. Keep the body warm,, especially after work or exercise. Avoid chilling and direct drafts. Do not overdress.

4. Cold bathing is an aid. It trains the body to adjust itself readily to rapid changes in temperature.

5. Rest in bed is the most valuable single item in the treatment of colds.

The ear. In recent years large groups of individuals have had their hearing tested by a very accurate device called the audiometer. It was found that a very large number of persons had some degree of deafness back of which was most often found a history of chronic tonsil or adenoid infection or enlargement in childhood, or one of repeated colds.

The eustachian tube leading from the middle ear to the throat is in a position to receive infection from the nose and sinuses. It may serve to convey infection to the ear or mastoid. Usually the ear infection is accompanied by pain; however, a chronic catarrhal infection may be established that produces no pain and slowly reduces the hearing. Irrigation or snuffing of solutions into the nose can affect the ear in a harmful manner, that is, by washing infection into the ear through the eustachian tube. Violent blowing of the nose or excessive diving and underwater swimming may alter the pressure within the ear to such an extent that the normal elasticity of the ear drum is changed.

Wax in the ear canals helps to keep the ear clean and free from infection. It also reduces the macerating effects of prolonged exposure to water. Wax should never be cleaned out except when it is in great excess. Careful syringing of the ear with warm water is the only safe method for the removal of wax. Never use pins, hairpins, or any stiff instrument to remove wax. The same is true regarding the removal of any foreign body that may get into the ear. The safest procedure is to see a physician regarding any trouble with the ears.

Deafness and ear infections can be greatly reduced by early removal of infected or enlarged tonsils and adenoids, removal of nasal obstructions, medical care for all earaches, care in blowing the nose, avoidance of using solutions through the nose except by a physician's order, and by moderation in diving and underwater swimming. The chief hazard to the ears comes from the common cold.

The eye. It is believed that 50 per cent of all adults have defective eyes as far as accurate vision and freedom from

some permanent defect are concerned. However, this does not mean that all visual defects require correction.

The most important period in life for preventing eye defects is childhood when the eye is still soft and plastic. At this time much reading with a poor light is injurious to vision. Early and repeated examination of the eyes is a good investment. The examination should be made by an oculist who is a regular physician with additional training in this speciality. Examination by the use of drugs, atropin or homatropin, to dilate the pupil is more accurate and without danger. During close work or study the eyes should be rested at regular intervals, at least every three hours. Good light coming from behind and above the reader is essential. It is important that the light be steady and not altered in intensity by any part of the lighting apparatus or shade. Reading in bed is a bad habit as it is almost impossible to hold the reading material in the correct position.

The eye is one of the first organs to be affected by poor health. The eyes need little care to be kept well. Most eye washes, drops, and medicines to make the eyes strong are valueless. Wear correctly fitted glasses, when needed, and observe the ordinary rules of hygiene if you wish to have satisfactory vision.

CHAPTER V

EFFECTS OF CERTAIN DRUGS UPON THE HUMAN SYSTEM

Narcotics and Drugs. The narcotic or intoxication impulse arises in youth from the desire to increase the joys of life through unrestrained emotions. In later life the impulse comes from a desire to avoid the present and forget the future and eliminate, if possible, the past. Drunkenness or intoxication in youth is the by-product of that which is desired, namely, excitement. In individuals of advanced years intoxication is the end in itself whereby forgetfulness is produced.

It is difficult to explain why so many individuals, against all their self interests, against all religious, social, and intellectual teaching in self control, are unable to restrain themselves from the indulgence in narcotics, which always leads to inevitable destruction. This destruction is complete; not only are the body and mind lost but, worst of all, the personality declines to obliteration.

The only solution to this problem lies in the realm of personality. In certain psychoneurotic or unstable individuals, intoxication and drug addiction are an expression of the desire to escape the problems and circumstances of a life that is too difficult. This particular individual has a keen sense of inferiority and only hopes to pass as being as quick-minded and resourceful as his companions. The tendency to intoxication is strongest in the early twenties; after that, especially after thirty-five, the narcotic impulse prevails. Nations of the west and especially those of the cold climates seek narcotism in alcohol. Eastern nations and people of the warm climates prefer drugs for narcotism. Overcrowding, low wages, and unhygienic surroundings all tend to increase the use of intoxicants. The desire to produce an abnormal mental state by the use of any drug is a complete confession that the personality is incapable of facing the sterner realities of life.

Alcohol. Substitute one or more hydroxyl groups for an equal number of hydrogen atoms in the hydrocarbons and the result is anyone of the class of organic compounds called alcohol.

It is widely present in nature, occuring when there is fermentation and decaying of vegetable matter, through the action of the microscopic yeast plant. It is not surprising, therefore, to learn that alcoholic beverages in one form or another have been known and used from the very earliest times.

While there are many useful purposes to which alcohol may be put, it may, for present purposes, be appropriately placed among the group of drugs called narcotics because its chief action when taken into the body is to depress the function of all the tissues. This action may best be understood if the course of alcohol through the system, after having been taken by mouth, is followed.

Most of the alcohol which has been drunk is absorbed from the stomach and though this absorption takes place rapidly, so long as the alcohol is in the stomach local irritative effects occur which include an increased outpouring of gastric juices and of mucus. The gastric juices thus secreted have a much higher hydrochloric acid content than is needful and a much lower pepsin content. The albumens of food are converted by the alcohol into albuminoids, which are less readily soluble. Furthermore, the normal motility of the stomach wall, which is so essential to proper digestion, is considerably slowed down. The increased secretion of mucus is a defense reaction on the part of the stomach to protect its wall from the irritative effect of the alcohol, and it rightly might be termed a catarrhal gastritis which not infrequently results in a chronic condition in persons who habitually use alcohol in concentrated form.

Alcohol, having been absorbed by the stomach, and by the intestines also, is rapidly distributed by the blood throughout the body tissues. These tissues are affected to a degree proportionate to the concentration of the alcohol in the blood.

One of the principal functions of the tissues is oxidation, and it is this activity which is slowed down in the presence of alcohol. The blood being a tissue likewise is affected, depend-

ent upon the amount of alcohol present and upon the rate at which it is being drunk. It diminishes the oxygen consumption of red blood corpuscles, thus indirectly prevents tissues from receiving the required amount of oxygen to function properly.

With the lowered oxygen capacity of the blood added to the depressant effect directly exerted on respiration by large amounts of alcohol, the ill effects of diminished pulmonary ventilation may readily be appreciated.

All observers agree that large amounts of alcohol are injurious to the heart muscle. It not only has this immediate effect but also an indirect one by causing the heart to beat more rapidly through lessening of the normal inhibiting influence on the controlling center in the brain. Thus the heart must exert itself more to accomplish a given amount of work.

The blood pressure is affected by alcohol in this manner: Following the drinking of alcohol there is a dilatation of the capillaries in all parts of the body and a resultant fall in blood pressure. There is experienced a false sense of warmth at the body surface, but since there is an increase in radiation of heat from the body because of the greater amount of blood in the skin there is a consequent lowering of the temperature. This explains the danger of drinking alcoholic beverages, when exposure to cold is contemplated, with the view of keeping one warm.

The most pernicions effect of alcohol is noted in connection with the mental and sensory as well as motor functions of the brain. Here its action is that of a narcotic and is decidedly depressant. Acuteness of sensation is diminished; coordination is interfered with; judgment is impaired. Therefore in tasks that require quick response to stimuli and good judgment, alcohol is to avoided.

The man who does not begin to drink before he is twenty-five years of age is much less apt to become a drunkard or a habitual user than he who begins before he is twenty, and there is a good chance that, if he abstains until the greater age, he will always do so. On the other hand, the impossibility of knowing who are, and who are not, capable of using alcohol judiciously should prevent our encouraging what we regard

as judicious use in soldiers. Every military post used to show in its guard reports, its sick reports, and in unrecorded ways the injury and loss of service resulting from excessive use of alcohol; so that it is not necessary either to quote military statistics or to go to civil life for the lesson. The inability to procure other liquor may lead men who are habituated to its use and crave it to drink flavoring extracts, perfumery, and wood alcohol. It is important to know that wood alcohol and its preparations are more poisonous than ordinary alcohol, and that death, or complete and permanent blindness, may follow their use.

Not only is alcohol the direct cause of such diseases as delirium tremens, alcoholic neuritis, and gastric catarrh, but it is also a predisposing cause of many other diseases. It predisposes to infections, both by making its user careless in regard to them and by lowering the resisting powers. Drunkards are especially subject to pneumonia, and are also especially unfavorable subjects for that disease. The chronic gastric catarrh of the old alcoholic may make him an easy victim for cholera or typhoid.

Opium. Opium in the crude form or in alcohol, as laudanum, has been used as an intoxicant for many centuries. Opium smoking requires a long period for the formation of the habit. The beginner usually experiences many unpleasant reactions such as profuse sweating, unsteady gait, ringing in the ears, and nausea that almost always turns to vomiting. Some novices complain of severe itching and an intense fear of some catastrophe. The desired exhilaration is less easily obtained as the habit becomes established. Prolonged use causes marked mental and nervous instability and irritability and periods of despondency.

Morphine has to a great extent replaced the use of opium. Damage to the memory occurs early, names and recent events are quickly forgotten while memories of past events remain vivid. The sense of responsibility is lost; and power to act diminished; one is not able to force a decision or action on oneself. Stomach and intestinal disorders always develop. As the personality breaks down, trustworthiness and honesty give way to deceit

and falsehood. Hallucinations may completely incapacitate the addict.

Heroin is a derivative of morphine. Unlike morphine or opium, heroin stimulates the individual, inflates his personality, removes all sense of moral restraint, and finally produces a savage-like person who without hesitation pursues an anti-social course.

Cocaine. Cocaine is a stimulant as well as a narcotic. Cocaine addicts show great activity. They are talkers and love to boast of their powers and ambitions. Although they are quick to react to any situation, their judgment and responsibility are so poor that they are dangerous. Usually, ideas of persecution are developed, and hallucinations may become so intense as to render the habitue a real menace.

Marihuana. Marihuana, sometimes referred to as "Mary Warner" is derived from the flowering tops of a weed which grows abundantly throughout the southwest and old Mexico. It is a variety of hemp, Cannabis Americana. In other parts of the world the drug is variously known as Indian Hemp, bang or bhang, Cannabis Indica, Hasheish or hashish. Marihuana ordinarily is introduced into the body either by smoking the dried weed or by swallowing, although there are other modes of administration. In this country it is commonly used in cigarettes called "reefers" or "muggles." Two reefers are usually sufficient to confer the desired effect.

Most often the Marihuana habit is begun by youths of High School age, seeking new thrills and excitement. Statistics show that most Marihuana devotees are found in age groups under 30.

There is no rational indication for the use of the hashish in medicine, particularly because of its uncertain action.

The effect of the drug is principally exerted on the brain. In general, the first response is a feeling of well-being, merriment, comfort, and self-satisfaction. Often, however, less pleasant thoughts obtrude themselves such as fear of impending death or of some imminent, indefinite danger. Ideas flash through the mind without apparent continuity, and all meas-

urement of time and space is lost. Usually time is shortened and space is lengthened although in some users this may be just the opposite. There may be color distortion: objects have varied hues and shades of color, and the colors continually shift from one object to another. The faces of others may assume grotesque expressions and surrounding objects change form.

This drug destroys sanity even more seriously than opium. The habitual use of the drug destroys will power, releases inhibitions and restraints, and provokes immoderate and abnormal reactions which result in wild debauchery, sexual crimes and even murder.

CHAPTER VI

FIRST AID

First aid is the temporary emergency care given in a case of sudden illness or accident before the services of a physician can be secured. This period of temporary care, if intelligently given, will often save a life. In all cases first aid, properly administered, will reduce mental and physical suffering and thereby place the patient in the physician's hands in a better condition to receive further treatment. Very often the only first-aid care that is necessary is to prevent further injury to the patient by well meaning but ignorant onlookers.

General Directions.

1. Do not move patient, unless it is vitally necessary to do so, until the extent of the injury is determined. Keep the patient lying down in a comfortable position with the head level with the body.
2. Keep the patient warm; be sure he is well covered and is not being chilled from contact with the ground.
3. Do not give liquids to an unconscious patient; they may enter the windpipe and strangle him.
4. Do not move the patient hurriedly or roughly; keep cool yourself; keep bystanders away from the injured.
5. Call a medical officer; do not attempt to give the treatment that only a physician should employ.

Wounds.

A wound is a break in the skin or in the mucous membrane of one of the body cavities. Incised wounds are made by sharp-cutting instruments such as knives, razors, and broken glass. Lacerated wounds are often irregular and torn. They are caused by contact with angular surfaces, by shell fragments, by machinery and the like. The puncture or stab wounds are caused by such penetrating objects as nails, wire or bullets.

Bleeding, shock and infection are the principal dangers from any type of wound. Rapid bleeding requires immediate attention. In most cases bleeding is readily controlled. Infection can occur whenever the skin surface is broken. The size or location of the wound is not related to the possibility of infection; a skin puncture with an ordinary pin may start infection. A wound should never be touched with anything except sterile dressings or instruments. Unclean hands, bandages, or instruments may infect a wound that is relatively clean.

Wounds in which bleeding is not severe. In these cases the chief duty is to keep the wound clean and prevent infection. If an antiseptic such as iodine is available and the wound is small, apply this gently to the wound and to the skin for an inch around the wound. If the wound is large apply the antiseptic only to the skin around the wound. Allow this to dry well, then apply a sterile dressing. If neither antiseptic nor dressing are at hand, do not apply a substitute but allow the wound to remain open; bleeding will usually stop in a few minutes.

Things one should not do:

1. Touch the wound with the hands, mouth, clothing or any unclean object.
2. Wash the wound with any solutions such as soap or water, as this will always carry germs into the wound.
3. Massage or squeeze any wound; you may start severe bleeding or injure the tissue more.
4. Attempt to explore the wound with any object or remove blood clots.
5. Reapply antiseptics such as iodine. Never use iodine in the eyes or in any body cavity.

Wounds with severe bleeding.

Pressure is the only first-aid method for the control of bleeding. If sterile gauze or bandage material is available, this can be used by direct pressure on the wound and held in place until a dressing is applied or a tourniquet adjusted.

When direct pressure to the wound is not possible, or when the direct pressure does not control the bleeding, apply pressure with the fingers or with a tourniquet between the cut and the heart. At certain places in the body large arteries lie near bones and may be compressed so as to decrease the flow of blood through them. The six principal pressure points where these main arteries lie close to bone are:

For the artery to the head and neck:

1. In the neck just to the side of the windpipe, against the backbone.
2. Just in front of the ear, against the skull.
3. About an inch forward from the angle of the jaw. where a large branch crosses the jaw bone.

For the artery to the shoulder and arm:

1. Behind the inner end of the collar bone against the first rib.
2. On the inside of the upper arm, half-way between the shoulder and the elbow.

For the artery to the lower limbs:

1. In the groin as it passes over the pelvic bone. However, the point about a hand's breath below the groin on the inside of the thigh is used for the tourniquet.

Applying a tourniquet is a dangerous procedure and should not be used if bleeding can be stopped by other means. A tourniquet may be used with a pad over the artery; the tourniquet itself should be at least an inch wide. Never use a rope or wire. The tourniquet cuts off the entire blood supply to the injured part; so it is necessary to loosen the tourniquet every 15 or 20 minutes. Never cover the tourniquet with a bandage or splint; it may be forgotten and not loosened as necessary.

Shock is always present with severe bleeding. Do not give any stimulants until bleeding has stopped. Two sites should be remembered for applying a tourniquet to control bleeding: For the arm, forearm, and hand, apply tourniquet around the upper arm about a hand's breadth below the armpit For the thigh, leg, and foot, apply the tourniquet around the thigh about a hand's breadth below the groin.

All wounds, especially puncture wounds caused by gun powder or dirty objects, are subject to additional danger from

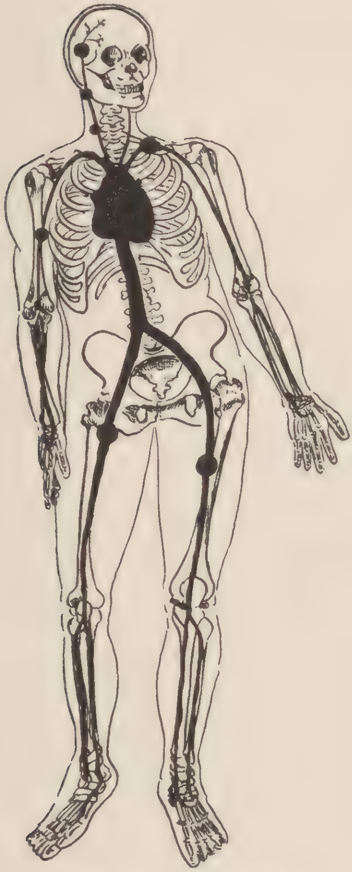

Fig. 8. The skeleton with pressure points.

infection by the tetanus, or lockjaw, organism. Wounds contaminated by soil or street dirt are frequently infected by the organisms of gas gangrene. In all cases of this nature a physician should be consulted so that special care can be given the wound and, if necessary, serum containing antitoxin against tetanus or gas infection can be administered.

Shock. Shock is a profound depression of all physical and mental processes. This condition usually results from injury, but it may be caused by exposure, bleeding, fatigue, hunger, or extreme emotion. Some degree of shock follows all

injuries; it may be slight, lasting only a few minutes, or it may be prolonged and end fatally. Where an injury of any type is severe it can safely be assumed that a corresponding degree of shock will be present. Even if evidence of shock has not appeared after severe injury it is well to anticipate it and to help prevent it by instituting shock treatment. The characteristics of shock are: Listlessness or stupor; irregular, gasping breathing; weak and rapid pulse; and a general loss of sensibility. The face is pale and covered with cold perspiration. The patient often complains of being cold and nauseated. First aid treatment of shock requires heat, correct position of the body, and stimulants.

Heat applied to the body of an injured person is most important both in preventing and in treating shock. All types of additional clothing may be used; external heat with hot water bottles, hot bricks, or pads may be used freely, keeping in mind that it is easy to burn a person who is in shock or unconscious. Rubbing the limbs is of doubtful value. In examining the person remove no more clothing than is necessary and replace it immediately when through.

The position of the patient will greatly affect the blood supply to vital organs. Lay the patient on his back with the head low. This can best be done by raising the foot of the bed about one foot.

Stimulants can be used only with conscious patients; they should never be given to bleeding patients or those suffering from a skull fracture, apoplexy, or sunstroke. A teaspoonful of aromatic spirits of ammonia in water is very satisfactory, or a cup of hot coffee or tea may be used to good advantage.

Artificial Respiration. Asphyxia, suffocation, or stoppage of breathing occurs most frequently in drowning, electrical shock, or gas poisoning.

The prone pressure or Schafer method is the safest and most effective method of artificial respiration. As soon as the person is rescued the mouth should be forced open and any foreign substances such as gum, false teeth, or food, should be removed. As every minute is valuable, begin actual resuscitation without further delay.

Standard technique.

1. Lay the patient on his stomach so that his face is free for breathing. One of his arms should be extended over his head, the other bent at the elbow so that his face can be turned outward and rested upon his hand.
2. Kneel astride the patient's thighs, with your knees placed at such a distance from his hips as will allow you to exert the pressure on his lower ribs as described below. Place the palms of your hands on the small of his back with your fingers on his lower ribs, your little fingers just touching his lowest rib, with your thumbs and fingers in natural position and the tips of your fingers out of sight just around the sides of his chest wall.
3. With your arms held straight, swing forward slowly so that the weight of your body is gradually brought to bear upon the patient. Do not bend your elbows. This operation should take about two seconds.
4. Now immediately swing backward so as to remove all pressure completely and suddenly.
5. After about two seconds repeat the operation. The movement of compression and release should take about four or five seconds; this should be done at the rate of about twelve to fifteen unhurried respirations per minute.
6. Continue the operation without interruption until natural breathing is restored or until a physician declares the patient dead. Remember, many patients have died because artifical respiration has been stopped too soon. Always continue the operation for four hours or longer.
7. Aside from the resuscitation the most valuable aid that can be rendered is keeping the patient warm. After artificial respiration has been started have an assistant loosen the clothing and wrap the patient in any clothing that is available. Use hot

bricks, pads, heaters, or similar means, but be sure the person is not burned.

8. When the patient revives he should be kept lying down and not allowed to stand or sit up; this will prevent undue strain on the heart. Stimulants, such as hot coffee or tea, can be given provided the patient is perfectly conscious.
9. At times a patient, after temporary recovery of respiration, stops breathing again; artificial respiration should be resumed at once.
10. Due to the length of time this operation may be kept up, one, two, or more operators may be necessary. A change of operators can be made without loss of rhythm of respiration. If this point is remembered no confusion will result when the change occurs and the respiratory count will be kept even. The great danger is stopping artificial respiration prematurely. In many cases breathing has been established after three or four hours of artificial respiration, and there are instances where normal breathing has been reestablished after eight hours. The ordinary and general tests for death should not be accepted; a physician should make several careful examinations at various intervals before the procedure is allowed to be stopped.

Electrical shock. The rescue of the victim from a live wire is always dangerous. If the switch is near, turn the current off, but lose no time in looking for the switch. Use a dry stick, dry clothing, dry rope, or other dry non-conductor in removing the victim from the wire. Start artificial respiration immediately. Do not regard early stiffening as a sign of death; always keep up the artificial respiration for several hours.

Gas poisoning. Here again, the rescue is dangerous. A handkerchief tied around the nose and mouth is not a gas mask. The first thing after the rescue is to get the patient into the fresh air; this does not mean cold air. The fresh air of a warm room is desirable. If breathing has stopped, is weak or irregular, start artificial respiration. Oxygen is

an aid to these patients but does not take the place of artificial respiration. A physician should always be called for the patient may die even after normal breathing has been established.

Drowning. Immediately after removal of the victim from the water start artificial respiration by the prone method as outlined. Do not attempt to remove the water from the lungs by any other method. If it is possible and does not interfere with the maintenance of artificial respiration, see that the wet clothing is removed and the patient made warm.

Other causes of asphyxia such as blows on the head and abdomen, or burial in a cave-in, are handled in a similar manner.

Injuries Due to Heat and Cold. **Burns** may be caused by dry or moist heat, electricity, and chemicals. They are classified in degree according to the depth to which the tissues are injured:

First degree—the skin is reddened, as in sun burn.

Second degree—the skin is blistered, as from contact with boiling water.

Third degree—The skin is destroyed or charred, as from contact with flames.

First degree burns. The treatment is directed toward the relief of pain, since the skin is unbroken and there is no danger from infection. Any substance that will relieve the pain is satisfactory. An oily substance such as petrolatum (vaseline), olive oil or castor oil is usable. Cold water or soda in water is soothing when immediately applied. It must be remembered that if the burn is at all serious oily substances are not to be applied.

Second degree burns. Here the injury must be regarded as an open wound; only material that is known to be sterile can be used. Remove the loose clothing, but do not try to remove material that adheres to the skin. Sterile gauze soaked in a solution of Epsom salts, two tablespoonsful to a pint of boiled water, is very good. The dressings should be kept moist and warm until further aid is obtained. Gauze moistened with 5 per cent tannic acid is of great value. Never apply iodine or

like substances to a burn, and never use absorbent cotton next to a burn. Shock is always present, to some degree, in every case.

Third degree burns. These are always serious and require the expert services of a medical officer. After the procedure described for second degree burns has been carried out as an emergency measure the patient should be kept warm and in the position for shock treatment; then a medical officer's services should be obtained.

Chemical burns. Burns caused by acids or alkalies should be washed with large quantities of water, preferably not too cold, until the chemical is thoroughly removed. All clothing should be cut away with scissors. Apply a moist dressing after the chemical is completely removed and secure a physician's services. Phenol or carbolic acid burns should first be washed with alcohol, if readily available. Eye burns, from chemicals, require careful attention. The best first-aid treatment is to flush the eye thoroughly with clean olive oil, mineral oil or castor oil. If these are not available use water; a drinking fountain that throws a stream is excellent for this purpose. The eye should then be covered with a moist dressing and medical aid secured.

The first aid treatment of casualties from chemical agents used in warfare will be discussed elsewhere in this chapter.

Sunstroke and heat exhaustion. Both these conditions are caused by excessive heat, but they differ entirely in their symptoms and treatment.

Sunstroke is a very dangerous condition; it is caused by direct exposure to the hot rays of the sun, especially when the air is moist. The symptoms are: Headache, dizziness, oppression, and sometimes vomiting; the skin is hot and dry, and the face flushed; the pulse is rapid and full; the temperature is high, often ranging between 107 and 110 degrees. Unconsciousness usually occurs and the body becomes relaxed; however, convulsions may occur.

Treatment of sunstroke. Remove the person to the shade and a cool place if possible; loosen or remove the clothing. Lay the patient on his back with the shoulders and head elevated. Apply

cold to the head by means of wet cloths, ice bags, or ice. The brain cannot withstand the effects of high temperatures.

Cool the body by cold baths for twenty minutes at a time, with brisk massage to the limbs and trunk. Cold wet cloths or ice bags may be used. Wrapping the body in a sheet and pouring on cold water every few minutes is probably best. Do not overdo this procedure. Stop every few minutes to observe the patient. If the skin again gets hot repeat the treatment. Give no stimulant while unconsciousness lasts.

Heat exhaustion is caused by exposure to high temperatures as found in boiler rooms, foundries, bakeries, and similar places. The first signs are dizziness, nausea, and uncertain gait. The face is pale, and the body covered with a profuse perspiration that causes the skin to have a cold clammy feeling. Breathing is shallow, the pulse is weak, the temperature may be normal or somewhat elevated. Fainting may occur, or prostration may become severe. The treatment is to remove the patient to circulating cool air, place him in a supine position, and let him freely drink cool salt water (one teaspoonful of table salt in a pint of water). Call a physician if the exhaustion does not pass away readily.

Frostbite. Rubbing of the frozen part is not good treatment. Rubbing with snow is especially bad as it bruises and tears the frozen tissues and may result in gangrene. Slowly thaw the frozen part by using extra clothing or apply the frozen part to another part of the body until it becomes warm. Do not expose frozen tissues to a hot stove or radiator.

Snake Bite. Snake bite accidents resulting in death are uncommon in our hemisphere. In all of the widespread banana plantations of the United Fruit Company in Central America their medical records show 23 snakebite accidents per 100,000 population per annum.

The reason that snake bite accidents in Central America seldom kill is a natural one. Most of all the venomous snakes are nocturnal in their habits. Food is plentiful and they are able any night to capture and swallow a rodent. In doing this they discharge all of the venom that can be squeezed out of the glands into the rodent or other item of food. A snake

that has recently killed and ingested its meal will require from two to three weeks to secrete enough venom to fill the glands again. Only people who are abroad at night take the chance of being bitten by a snake with full poison glands.

Most snake bite accidents happen in the daytime, and in the majority of cases the snake that causes the accident is full of food or it would have made its escape. When a snake swallows a rat or other animal it cannot run well because the belly plates used in running are stretched so tightly over the "food ball" that they cannot function. They hide nearby until the meal digests and spreads itself out in the food canal. Baby snakes are not always able to find a meal that they can swallow so they may be found active after sunup trying to find food. These little specimens can cause very serious cases.

About 75 percent of snake bites are in the lower extremity. Most of these could be prevented by high topped shoes, boots or heavy leggings. About 22 percent occur on the hands and forearms. Anyone who is well shod and gloved is well protected even in a bad snake region.

In the United States, the rattlesnake and the moccasin (copperhead and cotton mouth) are the most common poisonous snakes. They can be distinguished from the non-poisonous snakes by the following characteristics:

1. They have triangular heads, thin necks and stout bodies.
2. A blind pit on each side of the face between the eyes and nostrils.
3. Elliptical pupils, like a cat.
4. Large fangs that fall back against the roof of the mouth in white membranous tissue sacs.
5. Single scales on the under surface. (Non-poisonous snakes have double scales from the vent to the end of the tail).

First aid for snake bite should start promptly. Apply a tourniquet (vine, weed, string or a piece of shirt) like a tight garter well above the knee or elbow, wherever the bite is located below these levels. The tourniquet should be applied firmly enough to prevent the flow of blood in the veins, but not tightly enough to prevent the flow through the arteries. In other words,

tie it tightly enough to cause the limb to become blue but not white. The tourniquet should be released for a few seconds, at intervals of ten minutes, in order to prevent gangrene of tissues below the level of the tourniquet. Tourniquets are not successful below the knee and elbow, because some vessels protected by bones are not effectively controlled. Many persons suffer more serious and lasting injuries from the tourniquet than from the venom.

Just as soon as it is possible to apply the tourniquet, or to have some one hold the thigh or arm with both hands in place of the tourniquet, one should begin the extraction of the venom. This is a most important step in first aid since one should immediately extract all that he possibly can in order to avoid absorption and to leave as little as possible for the antivenin treatment to control.

The first step in the extraction of the venom is to make criss-cross incisions through the site of the bite about ½ inch in length and ¼ inch deep. This is done with the hope that the channel into which the venom has been injected will be exposed and the poison will be washed away by the flowing blood or removed by the second step in the extraction which consists of suction. The mouth should not be pressed directly against the wound since the oral cavity is a veritable pest hole of deadly germs. Instead a square of very thin rubber dam can be laid over the wound and sucked against with safety. The commonest thin rubber available is the condom. One of these when cut down one side and the ends cut off is large enough to make two squares.

Vigorous sucking should be carried on over the wounds for about five minutes. Then wash the wounded area with water or other safe solution. In sucking, it is quite safe to press with the teeth at the same time in a wide manner about the wounds. Suction may also be applied by a breast pump or by a small funnel attached to a rubber bulb. Heating a bottle or a small glass in hot water or over a flame or by burning a small piece of paper in it, and then applying the mouth of the bottle tightly over the wound, affords considerable suction as the bottle cools.

If antivenin is available it should be administered subcutaneously and the sucking efforts must again be repeated over the wounds. Suction is applied for at least one-half an hour.

Keep the tourniquet in use for about an hour after the administration of the antivenin and then it may be removed.

It is important to kill and keep the snake responsible for the accident. This may be easy since the snake is apt to be nearby and unable to escape because of the "food ball" in its body. If the snake has a lump in its body then the patient did not receive a large amount of venom and the prognosis is good. If there is little evidence of a "food ball" then the case must be considered serious. Both the patient and the snake should be promptly sent to the hospital. It is important to have an accurate identification of the snake so that a proper antivenin may be used.

Prompt attention to the extraction of venom from the wounds is the most important thing in the management of snake bites and without waiting to move the patient or to send for a medical officer. Alcohol is contraindicated in the treatment.

Insect Bites and Stings. The proper removal of the stinger is important. This should be done by grasping the stinger with a pair of small forceps and removing it in its entirety. A paste made of baking soda, or a cold moist dressing, using a dilute solution of salt, soda, or ammonia is helpful.

Poisonous spider and insect bites should be treated in a manner similar to snake bites. In the United States, the female 'black widow' spider is apparently the only one capable of causing death. The female is glossy black to sepia and densely covered with very fine short hairs which give it a naked appearance. A characteristic crimson "hour glass" marking is found on the under side of the abdomen. As a rule the female is not aggressive unless agitated, very hungry or guarding the egg sac. The bite itself—similar to a pin prick—is not always felt and often there is but little local evidence of the bite. The clinical signs are likely to resemble those of an acute appendicitis. Death seldom occurs except in the very young or very old.

For a discussion of the treatment of chigger, jigger and tick bites see Chapter XIV.

Fractures. A fracture is a broken bone. A simple or closed fracture is one in which the broken bone is closed to the air and infection, there is no communicating wound from the break in the bone to the skin. A compound or open fracture

is one in which there is a skin wound communicating with the broken ends of the bone.

Signs of a fracture: pain and tenderness at the point of the break; partial or complete loss of motion; the broken part is deformed; swelling and later discolorations occur; crepitus or grating may be felt but no attempt should ever be made to elict this grating; shock is usually present. Remember, all symptoms are not present in every fracture.

Treatment of simple fractures. Splint the patient where he lies. Do not transport or move him about until after some type of splint is placed in position. Improper handling of a patient may cause the sharp ends of the bones to injure nerves, cut through vessels, or even pierce the skin and thus produce a compound fracture. In splinting a simple fracture of an extremity, place the limb in as near the natural position as possible by taking hold of the lower part of the limb and pulling gently and steadily. At the same time an assistant should support the part of the limb on either side of the break in order to steady the bone. Then hold the limb in this nearly normal position until some type of splint can be applied. If a traction splint is not available, improvised splints can be made of any type of rigid or semi-rigid material. They should be as wide as the limb, always well padded with clothing, and long enough to immobilize the next joint in either direction from the fracture. Pillows, blankets, or even newspapers can be used for padding. Pieces of tin or mesh wire make excellent splints. After the splint is in place it should be tied on rather loosely, as a fractured limb usually swells considerably within one or two hours. For this reason the limb and the splint adjustment must be examined every twenty minutes to be sure that the circulation is not obstructed. Also, if much pain develops the splints and bandages should be examined.

Following the adjustment of the splint the patient should be placed in a comfortable position and treated for shock. Keep him warm and give him any available stimulant.

Treatment of compound fractures. If severe bleeding is found, check this with pressure between the wound and the heart, then apply a tourniquet. Even where bleeding is

not present it is a safe precaution to place a tourniquet loosely around the part, so that if bleeding should start it can be stopped immediately. A tourniquet should never be bound in with the bandages or splint; it may be forgotten and not released when necessary.

Traction splints should always be applied to compound fractures of the extremities before the patient is transported.

If the bone is protruding, do not attempt to push it back in place with the hands or instruments. Apply iodine, first, to the exposed bone, next, to the parts of the wound about the bone, and finally, to the skin over a wide area about the wound Place a sterile dressing over the wound.

After the bleeding has been controlled and the wound dressed, a traction splint should be applied.

Skull fracture and concussion of the brain. Any person receiving a severe blow on the head or who has been rendered unconscious even for a very short period of time, should be kept quiet until examined by a physician. Head injuries should never be regarded lightly, as frequently the serious symptoms following such an injury do not appear for some hours.

Treatment. Move only in a recumbent position and handle very carefully. Apply cold cloths or an ice bag to the head. Keep the patient lying down with the head slightly raised. Do not give stimulants. Keep the patient warm.

Dislocations and Sprains. When a bone gets out of place at a joint the condition is called a dislocation. A sprain is an injury or bruise to a joint. In these conditions the pain is usually severe, marked swelling occurs rapidly, and shock is present.

Treatment. Elevate the part. If this is an upper extremity, elevate by means of a sling; if the lower extremity, have the patient lying with pillows, coats, or other support, under the leg.

Apply cold applications to the site of the injury to retard the swelling and reduce the pain.

If shock is severe, apply heat to the body and call a physician at once.

When in doubt treat the case as a fracture and apply splints, especially if the patient must be transported.

Never attempt to reduce or correct a dislocation, as permanent damage may be done to the joint.

Poisons. The two principal points to be remembered in the treatment of poisoning are: Poisons when diluted are not absorbed as rapidly as when they are in a concentrated form. Clean out the stomach by causing vomiting, or washing; continue the washing until the returned fluid is clear. The following fluids are useful in producing vomiting: Soap suds, from any type of soap; salt water, or soda water; lukewarm water; milk, especially for corrosive poisons.

Give four to seven glassfuls, preferably lukewarm. Tickling the throat with the finger, after drinking of the fluid, will usually induce vomiting. A large dose of Epsom salts may safely be given after the stomach is cleaned out.

For carbolic acid (phenol) poisoning, give soap suds with Epsom salts. For the corrosive poisons such as bichloride of mercury, give milk or the whites of eggs.

For sleep inducing drugs, the patient must be kept awake by physicial exercise; strong coffee may also be used.

For strychnine poisoning do not give stimulants; keep the patient as quiet as possible; wash the stomach with weak potassium permanganate solution.

Most cases of poisoning show signs of shock. Heat is usually beneficial and artificial respiration may become necessary.

Common Emergencies. Foreign bodies in the ear. The only safe method is to syringe the ear canal with lukewarm water. If the object does not come out, consult a physician. Never use pins or wire to dislodge these objects, as there is great danger of seriously injuring the ear. Insects in the ear can usually be killed by dropping in a little oil and then washing the ear with a syringe.

Foreign bodies in the nose. These usually present no immediate danger. Gentle blowing of the nose may be tried; if unsuccessful drop in a little olive or mineral oil and consult a physician. Any attempt to remove the object with

forceps or wire usually causes more swelling and lodges the body more securely.

Foreign bodies in the eye. They are of frequent occurrence and are attended by considerable danger. Do not attempt to remove the foreign object with the fingers or to rub the eye. Close the eye for a few minutes until the worst of the irritation is over, then grasp the upper lid lashes and elevate the lid; repeat this process a few times. In many cases so treated the object will be washed out by the tears.

Where the above method fails a search must be made under the upper lid. To examine under the lid, have the patient look down, place the thumb near the edge of the lid and then with the other hand raise the lashes. Wipe the object with the corner of a clean handkerchief or irrigate the eye with water that has been boiled and cooled, using a small rubber ear syringe to direct the stream of water directly into the eye. This is a safe and easy procedure to try.

If the object is embedded in the eye or lid, or if there is difficulty in attempting to remove the substance, close the eye and apply a small bandage, just sufficient to keep the eye closed, and consult a physician. Never attempt to use a knife, toothpick, pin, or any similar object to remove an object from the eye. The eye is easily injured and must not be damaged by ill-chosen procedures.

Pain in the abdomen may be due to a variety of causes, many of which may be serious. In any case where pain occurs over all or in part of the abdomen, with nausea and vomiting, and accompanied or followed by pain and tenderness in the lower right part of the abdomen, appendicitis must be suspected. Always put these cases to bed at once and call a physician. Do not give a cathartic or laxative. Do not give any food.

Unconsciousness may be complete or partial. Frequently it is impossible to determine the cause, and treatment must be along general lines. An unconscious person with an odor of alcohol on his breath should not always be considered drunk. An intoxicated person may not have an alcoholic breath. It is always wise to consider the possibility of apoplexy and skull

fracture in every case of unconsciousness. In examining an unconscious patient, look carefully for the stoppage of breathing and for symptoms of poisoning, bleeding, or sunstroke, as special treatment for these must be given at once.

Treatment. Lay the patient on his back with the head and shoulders slightly raised. Apply cold cloths or an ice pack to the head. Insist on absolute quiet; do not move the patient unless urgent and then do so very carefully. Have sufficient cover to keep him warm. Use no stimulants until the patient is awake and some cause for the condition is found. Call a physician.

Fainting. Usually allow the patient to lie where he falls, if he can be made comfortable. Lower the head and shoulders by elevating the hips. Loosen the tight clothing. Sprinkling the face with cold water, and inhalations of ammonia or smelling salts are beneficial.

Convulsions or fits. Undress the patient or loosen his clothing and place him in a hot bath always keeping a cold cloth on the head. The bath water should be hot. Be careful not to burn the patient. To test the temperature place your bare elbow in the water for one minute; if it is comfortably hot and does not burn the skin, it can be safely used. A tablespoonful of dry, powdered mustard may be added to each gallon of water. If no tub is available wrap the patient in a heavy blanket or in towels wrung out of hot water. The pack or bath should be used for thirty minutes and repeated, if necessary. Following the bath the patient should be placed in a warm bed and given an enema. Always call a physician.

FIRST AID FOR CHEMICAL CASUALTIES IN WARFARE

General Considerations: Chemical warfare agents are classified according to their effects. Substances of widely different chemical composition may fall in the same group because their action on the human body is similar:

1. Lung Irritants
2. Blister gases
3. Tear gases
4. Irritant smokes (sneeze gases)

5. Incendiaries
6. Screening smokes
7. Systemic (internal) poisons

Lung Irritants. All chemical warfare agents may act as lung irritants under certain circumstances. The agents discussed here produce lung irritation as their most conspicuous effect.

Agent	*Symbol*	*Nickname*	*Form*	*Odor*	*Immediate Effects*
Phosgene	CG	Choky-gas	gas	Musty hay green corn	Coughing; tightness in chest, eye irritation
Chlorpicrin	PS	Puking-stuff	gas	Fly paper anise	Crying, coughing, vomiting
Chlorine	CL	Chlorine	gas	Pungent-like bleaching powder	Choking, coughing, pain in chest, smarting eyes

There is usually a latent period of 1 to 12 or more hours between exposure to lung-irritant gases and the development of symptoms. Cigarette smoke is unpleasant during this period and there may be no other indication that an individual has been gassed. This latent period always occurs after exposure to phosgene and may be longer than 12 hours. After exposure to chlorine there may be no latent period. After chlorpicrin, the latent period is short and may be less than one hour.

Persons must be kept quiet during the latent period even though they feel perfectly well. Any activity may cause sudden collapse. They must lie quietly and not attempt to feed themselves or even sit up.

First aid consists in removing the individual from the gaseous atmosphere and keeping the patient absolutely quiet on his back no matter how well he feels. Keep him warm with blankets and hot drinks. Artificial respiration should not be given in the hope of relieving difficult breathing as it may do serious damage. If symptoms appear, the patient should be given oxygen to breathe if available. The earliest possible skilled medical attention is essential.

Blister Gases. Because of their ability to render an area

uninhabitable for days, the blister gases are among the most important and effective chemical warfare agents. They are not true gases but are oily, volatile liquids. They may be used as bomb filling or may be discharged from an airplane as a fine spray which behaves as a gas. The liquid slowly vaporizes into a true gas. Both vapor and spray are heavier than air and tend to drift into and linger in cellars, ditches and other low places. In winter they persist longer than in summer.

The power of these agents is so great that a drop the size of a pinhead can produce a blister the size of a quarter. Exposure for 1 hour to air containing 1 part per million of vapor can cause a casualty. The eyes are particularly susceptible. The blister agents "soak in" as ink soaks into a blotter. This is not the same as "eating in" of an acid. The penetration takes place without damage to clothing. A patient may be sufficiently contaminated with mustard gas to cause extensive burns and show no signs of injury for 12 or more hours. The action of Lewisite or Ethyldichlorarsine is almost immediate.

There are two types of blister agents:

1. Those which cause only local surface irritation.
2. Those which also cause internal poisoning. These usually contain arsenic.

More than any other type of chemical agent, the blister gases, especially those containing arsenic, will poison food and water.

Agent	*Symbol*	*Nickname*	*Form*	*Odor*	*Immediate Effects*
Mustard	HS	Hot Stuff	Gas	Garlic, Horseradish, Mustard	No immediate effect—Smarting of eyes in 2 to 3 hours—skin burns in 12 hours or more.
Lewisite	MI	Mustard Irritator	Gas	Geraniums	Irritates nasal passages—Skin burns in ½-1 hour. Later produces signs of arsenic poisoning.
Ethyldichlorarsine	ED	Enemy's Delight	Gas	Biting—stinging.	Sneezing—vomiting. Causes arsenic poisoning.

Before treating a blister agent casualty, first aid personnel must apply to themselves those individual or collective measures which are necessary for their own protection, or they will also become casualties. A gas mask protects only the face, eyes and lungs. Protective ointment must be used on exposed parts and protective clothing worn where possible.

Mustard—Prevention—First Aid. To be effective, treatment must begin within a few minutes after exposure. Immediate prophylaxis is effective only up to five minutes after liquid contamination. It is of little value after exposure to the vapor because in this form most of the agent has penetrated the skin.

Contaminated clothing must be removed quickly. They should be hung in the air to rid them of the chemical agent or if a covered metal container is available, it is preferable to place them in such a container until decontaminated. Great care must be used in the removal of mustard from the skin; otherwise the agent will be merely spread. The steps are as follows:

1. Gently apply dry pads to absorb any mustard remaining on the skin.

2. Gently and repeatedly dab the area with sponges dampened with gasoline (non leaded, kerosene, carbon tetrachloride or alcohol. Have sponges only damp with solvents; if dripping wet the mustard will be dissolved and spread over the skin.

3. Scrub the skin surface within and beyond the margins of the contaminated area with soap and water.

4. Pat the area dry with a towel. Do not rub.

5. Burn or bury the materials contaminated during the procedure and keep away from the smoke of the fire as it may contain mustard vapor.

The protective ointment (Chemical Warfare Service) also effectively removes mustard from the skin surface if it is applied with rubbing and then wiped off. Products containing active chlorine, such as bleaching powder and bleaching solutions, may also be used. Bleaching powder should be mixed with 1 or 2 parts of water. Dry bleaching powder may be used if water is not available, but the reaction with mustard will generate heat. Even so, the effect will be less than if mustard were left on the

skin. Ordinary bleaching powder does not exceed 30 percent chlorine; high test bleaching powder of 70 percent chlorine should never be used dry because reaction with mustard will cause burns. Bleaching powder and solutions are irritating and must be removed from the skin in a few minutes. Be sure to keep them out of the eyes. Do not use them if the mustard burn has already begun to develop.

The eyes should be irrigated with a 2 percent solution of sodium bicarbonate (baking soda) unless they have been protected by a mask. The solution should be run directly into the eyes with a rubber tube from an enema can or similar container. Petrolatum on the edges of the eyelids will prevent them from sticking together. A 2 percent solution of butyn may be instilled in the eyes to relieve pain. Cocaine must not be used as it may cause ulceration. The eyes must not be bandaged.

If nausea and vomiting indicate that contaminated material has been swallowed, the stomach should be washed out by repeated drinking of warm 2 per cent solution of sodium bicarbonate. This will induce vomiting and wash out the irritant.

The patient should be placed under the care of a medical officer as soon as possible.

Lewisite—Prevention—First Aid. Prophylaxis must be instituted within 1 minute after exposure to be really effective against liquid Lewisite. Contaminated clothing must be quickly removed with the usual precautions, and, if possible, treatment should be started at the same time. Liquid Lewisite should first be removed from the skin by blotting. The Chemical Warfare Service protective ointment should be immediately spread over the contaminated skin surface and rubbed in vigorously. If this ointment has been used as a protective film and it has become contaminated with droplets or splashes of Lewisite, the areas of film containing the droplets or splashes should be wiped off and fresh ointment liberally reapplied and rubbed in at such points. The protective ointment should not be used on Lewisite burns after the reddening of skin has already begun as in such cases it will only aggravate the condition. Under such conditions or where the ointment is not available, the exposed area should be repeatedly swabbed with hydrogen peroxide. This may be used

in 8 percent solution. If this solution is not available, hydrogen peroxide USP 3 percent may be substituted. Fresh swabs should be used for each application and should be destroyed as soon as used. If peroxide is not available the contaminated skin areas should be swabbed with a solution of 10 percent sodium hydroxide in a 30 percent solution of glycerin in water, alternating with 70 percent alcohol. If no glycerin is available, 5 percent lye in water may be used. Following treatment, the skin should be washed with soap and water and patted dry. Lacking all these, the solvents and technique described for mustard should be used. Solutions containing free chlorine should not be used however, since they will aggravate the condition.

Liquid Lewisite in the eyes is an emergency. The eyes should be treated immediately and repeatedly by the instillation of 0.5 percent hydrogen peroxide. The hydrogen peroxide solution is very irritating but failure to render proper first aid treatment is more dangerous than the eye inflammation caused by the peroxide. If the peroxide is not available, the eyes must be irrigated with a 2 percent solution of sodium bicarbonate. Delay may result in blindness.

Ethyldichlorarsine—First Aid. This agent is more irritating to the nose and throat than lewisite or mustard. It is less irritating to the skin. The immediate measures are the same as for lewisite. Nose irritation may be relieved by inhaling dilute chlorine from a small amount of bleaching powder in a wide-mouthed bottle or can. If vomiting is persistent the stomach should be washed out by repeated drinking of warm 2 percent solution of sodium bicarbonate.

Tear Gases. (Lacrimators). These are substances which produce severe but temporary eye irritation. Permanent damage rarely results. Tear gases are not persistent, except brombenzylcyanide which is as persistent as mustard.

Agent	*Symbol*	*Nickname*	*Form*	*Odor*	*Immediate Effects*
Chloracetophenone	CN	Cry now	Gas	Apple Blossoms	Makes eyes smart, shut tightly, tears flow.
Chloracetophenone solution	CNS		Solution	Fly Paper	Tearing, prickling or itching of skin.

Agent	*Symbol*	*Nickname*	*Form*	*Odor*	*Immediate Effects*
Brombenzylcyanide	CA	Cry always	Gas	Sour Fruit	Eyes smart, shut, tears flow. Effect lasts some time.

First Aid. The individual should be removed from the contaminated air and face the wind with the eyes open. If irritation is marked the eyes may be irrigated with boric acid or a 2 percent solution of sodium bicarbonate. The eyes must not be rubbed or bandaged. Skin irritation may be treated by sponging with a solution of 4 percent sodium sulfite in 50 percent alcohol. All symptoms usually disappear within an hour.

Irritant Smokes (Sneeze gases or sternutators).

Agent	*Symbol*	*Nickname*	*Form*	*Odor*	*Immediate Effects*
Adamsite (Diphenylamine-chlorarsine)	DM	Dirty-Mixture	Gas	Coal smoke no odor	Violent sneezing and running of nose with pain; sick, depressed feeling.
Diphenyl-chlorarsine	DA	Dopey-ache	Gas	Shoe polish no odor	Causes sick feeling and headache.

These agents are used to produce irritation of the nose, throat and eyes and are dispersed in clouds or smokes of very fine particles, rather than as true gases. Their action is so delayed that symptoms may not appear until after the mask has been put on. When this occurs, an untrained person may think his mask unsatisfactory and remove it, becoming a casualty from further exposure. These agents are very insidious. They have hardly any odor and are usually detected only when symptoms appear. A striking peculiarity of these agents is the mental depression they induce. Severely gassed persons may attempt suicide.

First Aid. Remove to pure air if possible. Inhalation of dilute chlorine from a small amount of bleaching powder in a wide-mouthed bottle or can is also effective. Headache may be controlled with 10 to 15 grains of acetylsalicylic acid (aspirin). There are no after-effects and recovery is in a few hours. Severely gassed persons must be watched for suicidal tendencies.

Incendiaries.

Agent	*Symbol*	*Nickname*	*Form*	*Odor*	*Immediate Effects*
Thermit	TH	The Heat	Incendiary	Odorless	Severe burns.
Electron bomb	None	None	Incendiary	Odorless	More severe penetrating burns than other incendiaries.
White Phosphorous	WP	White phosphorous	Smoke	Burning matches	Burning pieces adhere to skin and clothes.

The thermit on ignition forms a red molten mass of metal giving off an extremely hot reddish-yellow flame extinguishable with water. The electron bomb is a magnesium case filled with fast burning thermit. The thermit sets fire to the magnesium case which is the effective incendiary material in this bomb. It burns with a brilliant white, intensely hot flame. Water only increases combustion and may cause an explosion in a closed space.

First Aid. In the case of the thermit, spray the burning areas with water and remove pieces of material. Further treatment is as for ordinary burns.

In the case of the Electron bomb, the burning material must be removed and the further treatment is as for ordinary burns.

In the case of white phosphorous, keep the burn wet with water or wet clothes until the particles can be squeezed or picked out; because if air gets to the articles they will reignite. Warm water about 40° C (104° F), melts phosphorous and makes squeezing easier. If squeezing does not bring out the particles, they must be picked out with forceps. Do not use mud as formerly recommended as it may cause infection. Urine may be used if there is no other source of water. If copper sulphate is available apply a 5 to 10 percent solution to the burn. (Enough copper sulphate to make a good blue color.) This coats the phosphorous with copper phosphide, shuts out the air, and stops the burning until the particles can be removed.

After the phosphorous has been removed, further treatment is as for ordinary burns.

Screening Smokes.

Agent	*Symbol*	*Nickname*	*Form*	*Odor*	*Immediate Effects*
HC Mixture	HC	Harmless cloud	Smoke	Sharp-Acrid	None
White Phosphorous	WP	White Phosphorous	Smoke	Burning Matches	Smoke is harmless but burning particles may adhere to the skin and burn it.
Titanium Tetrachloride	FM	Floating Mantle	Smoke	Acrid	Harmless
Sulfur Trioxide chloro-sulfonic acid solution	FS	Fuming Spray	Smoke	Burning Matches	Prickling of skin, flow of tears.

The smokes do no damage in ordinary field concentrations but may be dangerous in heavy concentrations formed at the site of release. The smoke from white phosphorous is harmless, but particles from a shell explosion will cause burns and should be treated as described under incendiaries. The liquids, Titanium Tetrachloride and Sulfur Trioxide solutions, produce acid like burns of the skin. They are irritating and unpleasant to breathe but are not dangerous. Spray in the eyes may cause serious burns.

First Aid. This consists in washing with large quantities of water. In the eyes, this should be followed by irrigation with a 2 percent solution of sodium bicarbonate (baking soda).

Systemic (Internal) Poisons.

Agent	*Symbol*	*Nickname*	*Form*	*Odor*	*Immediate Effects*
Hydrocyanic Acid (HCN)	None	Prussic acid	liquid	Bitter almonds	Giddiness, headache, convulsions, unconsciousness, death.
Arsine (AsH_3)	None	Arsine	gas	Nauseating, garlic-like odor.	Shivering, giddiness, nausea, vomiting, collapse.
Hydrogen Sulfide (H_2S)	None	Hydrogen Sulfide	gas	Rotten eggs	Irritation of eyes, nose, throat. High concentrations cause unconsciousness and death.

First Aid. For hydrocyanic acid and hydrogen sulfide, first aid consists in the inhalation of amyl nitrite fumes and artificial respiration until a medical officer can begin medical treatment. Artificial respiration should be continued for hours even though it appears hopeless.

Persons exposed to arsine must be kept quiet and hospitalized as soon as possible. Meanwhile, they should be given large quantities of alkalies such as sodium bicarbonate, citrate or phosphate.

CHAPTER VII

WATER.

Requirements. Water comprises about 70 per cent of the body tissues. The amount changes in health within narrow limits, being kept reasonably constant by regulation of loss and gain. Water is used by the body in the digestion of foods, the excretion of waste materials and in maintenance of the body temperature. The daily exchange of water amounts to about 2,600 c.c. when bodily activity is minimal as for example in a sedentary occupation. The gains are from drinking 1,450 c.c., in food, 800 c.c., and by oxidation of food, 350 c.c. The losses are—as urine, 1,500 c.c., through the skin, 600 c.c., through the lungs, 500 c.c., and in the feces, 100 c.c. The minimum daily water requirements, therefore, are about 2,600 c.c. When muscular activity is greater and when external heat increases perspiration the intake must be much larger. Decreased water intake impairs health; an increased intake, with little muscular activity brings about an increase in body weight. Acute deprivation of water causes very serious derangement of the body and, if continued, causes death. When both output and intake of water are greatly increased during a comparatively short period of time muscular cramps frequently occur; this is believed to be due to the unusual loss of sodium chloride. Excessive drinking of water during marches in hot weather produces nausea, vomiting, weakness, and exhaustion. These symptoms are also probably related to undue loss of sodium chloride though the chemistry of the condition is not fully understood.

"Water Consumption." "Civilian Community."

The water consumption in a civilian community varies within wide limits depending upon the number of people present and the nature of their occupations. In small groups of people water is obtained by each family for its own use. In larger groups a common supply is used. The industries of the

people may make use of small or large amounts of water. If a sewerage system is in use there will be a considerable amount of water needed for its operation. In most American cities having a population of greater than 5,000 and a common water supply in use, the average daily water requirement is about 125 to 150 gallons per person.

Permanent Camps. The water consumption in permanent camps is practically the same as that in most American cities. The high consumption is due to the laundry facilities, post exchanges with improved sanitary devices for cleansing eating utensils, continuous flushing of toilets and urinals, besides the routine water needs. Daily water needs may vary considerably during the week, falling off on Saturdays and Sundays when large numbers of troops are away on furlough and reaching a peak on Fridays when preparations are being made for these week-end furloughs. Furthermore, during maneuvers the water consumption may drop considerably.

Temporary Camps. In temporary camps, 5 gallons per capita per day is considered a normal requirement. When transportation is readily available, 15 gallons may be supplied per person and when temporary pipe line distribution is in use as much as 50 gallons may be available per capita.
gallons may be available per capita.

Combat. In combat man lives under primitive conditions. Only the bare necessities of life can be supplied in order that the ammunition and other supplies essential for the success of the military mission may have priority. Water essential for life and the maintenance of bodily energy must be supplied, but the amount is just sufficient for drinking and cooking requirements, namely, 1 gallon per man per day. This minimum supply should not be maintained for a period of more than three days without an additional allotment for each man.

On the March and in Bivouac. When troops are on the march and in bivouac, 1 gallon per capita per day is considered as a minimum requirement. However, in view of the increased water procurement facilities in the modern infantry division, 3 to 5 gallons per man per day can be supplied under many conditions. Of course, it must be remembered that the supply of

water under bivouac and march conditions depends entirely on the accessibility to water sources and transportation. In addition, the figures that have been given are based on normal requirements in a temperate climate; troops operating in hot countries may require from 15 to 40 percent more water.

In allowing 3 gallons of water for a man each day, it is important to know how this water is to be used; 1½ gallons is for drinking and cooking; ¾ gallon for washing hands and face, and for shaving; ½ gallon for washing mess equipment; and the final ¼ gallon is that amount which will invariably be wasted. When 5 gallons can be procured and supplied to each man, the additional 2 gallons will be used for laundry and bathing.

Requirements for Horses and Mules. The normal requirement is ten gallons per animal per day. The minimum is 3-5 gallons per animal per day for a period of not longer than three days.

Water Sources. The original source of water is rain or snow. Water so precipitated may accumulate in streams, lakes, and ponds or may make its way into the soil. The former is then spoken of as surface water, the latter as ground water.

The ground water percolates through the soil until it reaches an impermeable layer of soil or rock along which it flows until a change or break in the underlying formation permits its passage to deeper levels, or a change in the overlying strata allows its escape to the surface. Ground water is of two kinds—that which lies above the first impermeable stratum known as shallow ground water and that which lies below this stratum known as deep or artesian water. Water making its way into the ground carries along materials in suspension and solution. The suspended materials will be filtered out to a lesser or greater extent depending upon the nature of the subsoil and the distance traveled. In sand subsoils the major portion of the suspended material is removed after a short flow. The most important of these materials in connection with the present discussion are pathogenic bacteria, particularly those capable of producing the intestinal diseases. The deep ground water, except in lime stone formations, is practi-

cally free from bacteria because of the prolonged filtering action to which it has been subjected. Limestone contains so many cracks that water passes through it without filtration. On the other hand, deep ground water will have dissolved many chemicals in its passage through the soil and its chemical content may render it unsatisfactory for domestic or industrial use.

Surface water. Surface waters have their origin in the run-off from precipitation and from the escape of ground waters to the surface. The streams carry large amounts of material washed in from the ground surface and in addition are extensively used in all inhabited countries to convey waste materials. The heaviest suspended materials begin to settle out as the current decreases. Organic material in suspension is gradually broken up and later destroyed by oxidation processes. It is popularly believed that a stream purifies itself in a few miles of flow. This is not true. Many streams in this country carry such heavy amounts of organic material from both human and industrial sources that their waters never become purified by natural processes.

Springs and wells, both shallow and deep, are the water sources most commonly used by small communities and individual families. Larger communities may obtain water from deep wells but usually streams and lakes are the sources. Military garrisons are supplied from deep wells and streams. Troops on field duty obtain their water mostly from streams.

Responsibility for Military Water Supplies. Water supply for military garrisons during peace and in the Zone of the Interior during war is a function of the Corps of Engineers. Stations may have their own supply, which are similar to municipal supplies, or may be supplied from adjacent municipalities. In the Theater of Operations water is supplied by the combat engineers within the divisions, by general service engineer troops, or by the specialized water supply battalions. There are times when a unit in the forward area may have to obtain and purify its own water. The Medical Department exercises a supervisory control over water supply in all situations in so far as source, adequacy and potability are concerned.

Temporary water supplies. All company and similar units of the Army are provided with equipment with which they may procure and purify water. This materiel is used when troops cannot otherwise satisfactorily be supplied with water. The equipment consists of water vehicles or containers in which water may be transported and water sterilizing sets, each set including a canvas bag in which water may be sterilized and the chemicals necessary for its sterilization.

Practically, all sources of water in the field should be considered as contaminated and not used until properly treated. Some sources are, however, better than others and it is a Medical Department responsibility to recommend the most nearly satisfactory source as well as to supervise the method of treating the water. A water reconnaissance is necessary to select the best source. The important factors to be considered in such selection are the type of water (ground or surface), location and availability, quantity and quality, and probable extent of contamination. The water decided upon should be as clean as possible and the heavier suspended organic matter removed by straining or settling. A pit dug 4-5 feet from the edge of a stream or pond and 3-4 feet below the stream level makes a suitable settling basin.

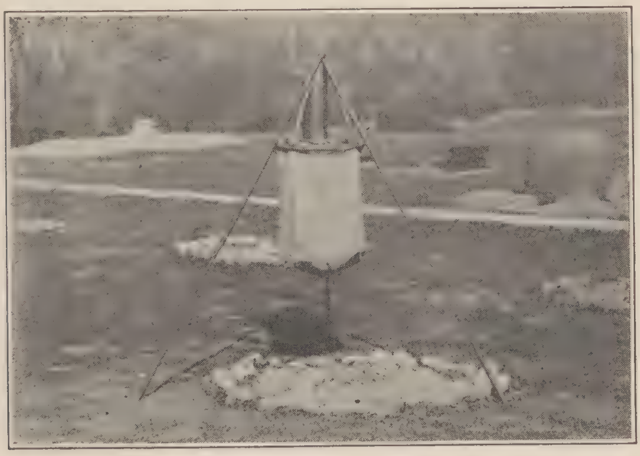

Fig. 9. Water sterilizing bag and tripod.

In the field, water is purified by two methods—boiling, and chlorination. Boiling is the safest method but is undesirable because of the flat taste it gives the water and because of the lack of containers for other than small quantities. Five minutes boiling is required for sterilization. Chlorination is the method of choice and may be carried out in the water sterilizing bag (Lyster bag), in water carts, or in small reservoirs, or by the portable and mobile purification units operated by the Corps of Engineers.

The technique of chlorination with the water sterilizing bag is as follows:

1. Suspend the bag on a tripod. Fill it with water to the mark 4 inches from the top, straining the water through cheesecloth. The capacity is 36 gallons.
2. Draw a small quantity of water (approximately a teaspoonful) through one of the faucets into a canteen cup.
3. Break an ampoule of calcium hypochlorite into the canteen cup, stir with a clean stick until a thin paste is formed, then fill the cup two-thirds full of water.
4. Empty the above solution into the water bag and stir thoroughly with a clean stick long enough to reach to the bottom.
5. Draw at least ½ canteen cup of water from each of the faucets and pour it back into the water bag. This serves to sterilize the faucets.
6. Wait ten minutes, then wash out one of the faucets by allowing a small amount of water to run through onto the ground. Then fill a clean canteen cup ½ to ¾ of an inch from the bottom (100 c.c.) with water from the same faucet.
7. Add one c.c. (15 drops) of orthotolidine testing solution to the water in the cup. Wait five minutes and note the color produced. Below is a guide for reading the reaction between free chlorine and orthotolidine:

Canary Yellow—Insufficient chlorine. Add more calcium hypochlorite.

Deep Yellow—Satisfactory chlorination, this represents about one part per million (ppm) of chlorine.

Orange Red—Over-chlorinated. Add more water and retest.

Bluish Green—Alkaline or hard water. Add a few more drops of orthotolidine to get a correct color reading.

8. Allow to stand thirty minutes after satisfactory chlorination has been accomplished. The unpleasant taste of over-chlorinated water is diminished by allowing it to stand several hours before using. It is a good plan to chlorinate water in the evening for the next day's use.

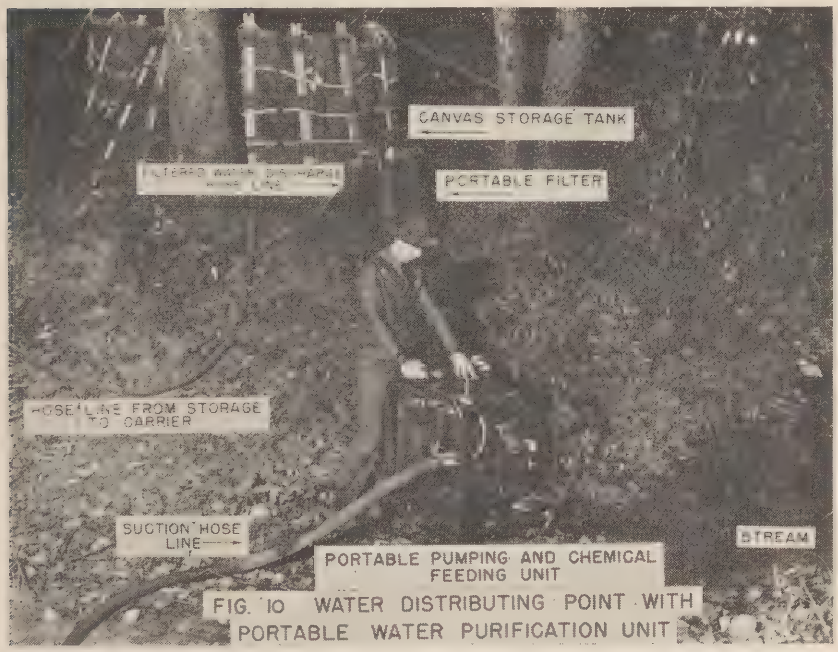

FIG. 10 WATER DISTRIBUTING POINT WITH PORTABLE WATER PURIFICATION UNIT

Canteen method. Fill a canteen with water and dissolve into it the contents of one tube of calcium hypochlorite (0.5 gms), being sure that it is evenly mixed throughout. Add 1 canteen cup (6 c.c.) of this solution to each canteen of water. Wait 30 minutes before drinking the water. This method is less accurate than chlorination in the water sterilizing bag and requires very close supervision of all individuals. The concentrated calcium hypochlorite solution may be prepared in a 1-quart bottle instead of in a canteen.

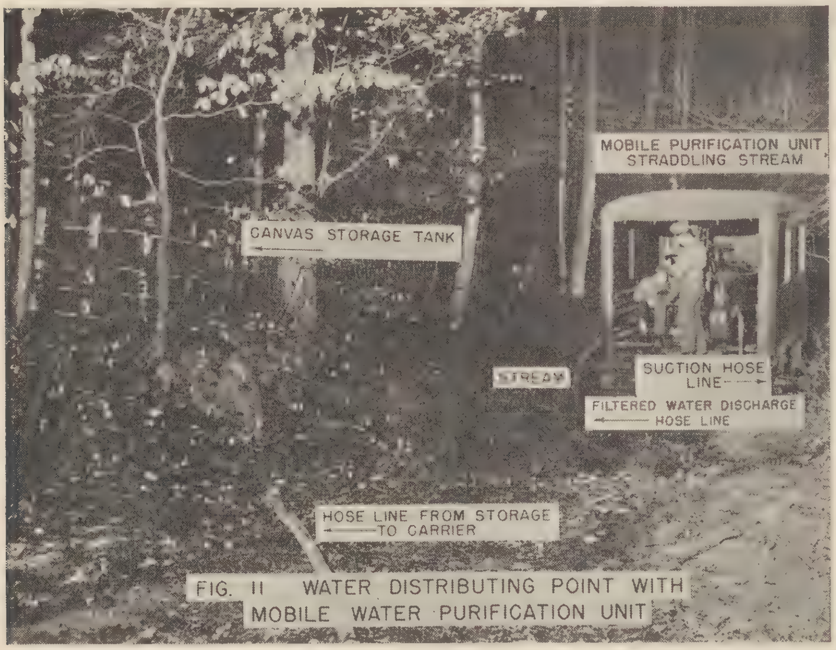

FIG. 11 WATER DISTRIBUTING POINT WITH MOBILE WATER PURIFICATION UNIT

Use of Iodine for Purification of Water. In the absence of calcium hypochlorite, tincture of iodine may be used as a temporary expedient. Two or three drops of tincture of iodine will purify one canteenful of water. This method is rarely practicable in combat since all available iodine will generally be needed for treatment of wounds.

Engineer Water Supply Equipment, consists of the portable purification unit and the mobile purification unit (Figs.

10 and 11). The portable purification unit consists of two sections, one for chlorinating and the other for filtering water. It delivers approximately 10 gallons per minute of purified water. Most Engineer Battalions, Regiments and similar Units have one or more portable purification units which are used for the usual procurement and treatment of water in the field.

The mobile purification unit is similar to the portable except it is larger with a greater capacity of approximately 70 gallons per minute of filtered and chlorinated water. It is equpiment of the Engineer Battalion, Water Supply which is so organized that one unit may be made available to a division and it is capable of supplying an entire division with the necessary water.

Additional Methods of Procurement of water are (1) digging of wells with mobile equipment and, (2) distillation.

The only way to free water from alkaline salts is by distillation. Generally, this method is used to supply drinking and cooking water only as a last resort. In military operations distillation is used primarily when it becomes necessary to depend upon sea water. It is used on shipboard for that reason, as well as in places on the seacoast or on small islands. It is sometimes used in countries where the ground waters are salt or alkaline. Distilled water is flat and unpalatable but the taste can be improved by aeration.

The Transportation of Water is usually accomplished by using standard 5 gallon water cans similar in construction to the gasoline cans. Care must be taken by each unit to see that these cans are clean at all times. Certain organizations, such as the Medical Battalions and some units of the Air Corps. have 250 gallon tank trailers used for the transportation, storage and distribution of water and if the need arises for the chlorination of water. The engineer water supply battalion is equipped with large tank trucks and trailers for water transportation.

The Storage of Purified Water is accomplished at water points or water distributing points with 3000 gallon canvas reservoirs. The units of company size use their water sterilizing bags for this purpose.

Protection of water supply. This includes that of both the raw and the treated water. The source should be guard-

ed. If from a stream it should be flagged as indicated in Fig. 12. Contamination from latrines and kitchen pits is prevented by placing them so that drainage is away from the water source. Shallow wells are unsuitable water sources in several respects. Unless they are located properly with respect to sources of contamination such as privy pits and barnyards, or if the covering of the well opening is such as to permit seapage into the well, they should not be used. The yield of shallow wells is generally too meager to provide an

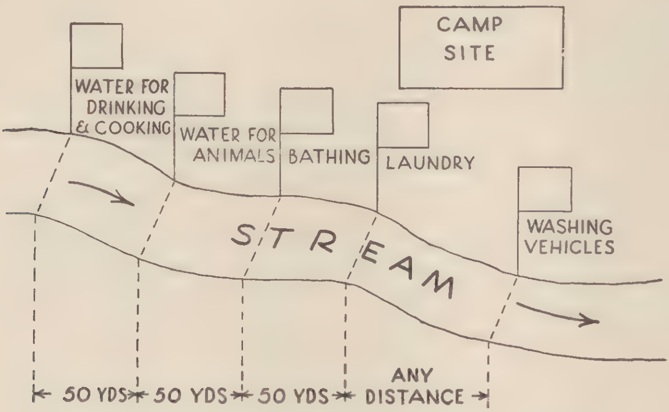

Fig. 12. Stream protection. Field water supply.

adequate amount of water. Mechanical difficulties are encountered in attempting to fill water vehicles from the usual well. The treated water in the sterilizing bag is protected by the use of a cover and by preventing withdrawal of water from it except through the faucets, and by forbidding the use of faucets as drinking fountains. Sterilized water in carts, trailers, or other containers must be protected from contamination.

Gas Contaminated Water. Water that is contaminated with warfare gases should be avoided if other supplies can be obtained. If not, contaminated water will be considered as potable provided it meets all of the following requirements:

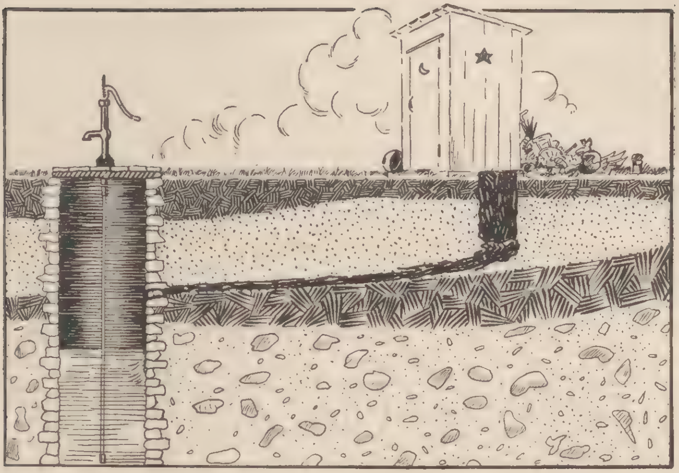

Fig. 13. Well pollution by seepage from pit privy.

(a) There is no odor of any chemical agent present in the water before chlorination.

(b) There is no excessive cloudiness or discoloration present.

(c) The addition of five parts per million of chlorine (2 ampules of calcium hypochlorite per Lyster bag) produces a chlorine residual of one part per million or more.

(d) The pH (acidity) of the water before chlorination is above 5.0.

These tests apply to all known warfare gases that may contaminate water supplies.

Treatment of contaminated water to render it potable is not feasible except by water supply personnel of the engineers who are especially trained for this task.

Water Discipline. In the field the maintenance of water discipline is an important function of every unit commander. Without it troops will drink from unauthorized sources along the line of march. This is to be avoided at all costs since all experience has shown that one of the most frequent causes for out-

breaks of 'diarrhea' is the drinking of water from unauthorized sources. In addition, it should be remembered that such serious diseases as typhoid fever, amoebic and bacillary dysentery and cholera are often transmitted by water. Without proper discipline, troops will use up more than their allowance of water and they may be left without it when they need it most and when its absence may mean the loss of a battle or even a campaign. Good water discipline will also avoid waste. Troops must be taught that water is too precious ever to waste.

CHAPTER VIII.

FOOD

Food Constituents. The constituents of a food are protein, carbohydrate, fat, mineral substances, and vitamins. Each of the food constituents is required for the maintenance of physical well being and no one of them can be wholly replaced by another over any considerable length of time without danger to health.

The proteins, carbohydrates, and fats are the nutrient constituents of the food. The primary function of protein is to supply the compounds required to rebuild the tissues that are being continually destroyed by the activities of the body. Carbohydrates and fats are the principal sources of the energy utilized by the body in the performance of work.

Protein. Proteins are contained in both animal and vegetable food materials. Lean meat and egg albumin are typical protein foods, but protein is also present in varying amounts in milk, legumes, tubers, leafy vegetables, and fruits.

Protein is broken down by the digestive and metabolic processes into its constituent amino acids.* The individual amino acids are in turn utilized by the body to repair and build body tissues, particularly muscular tissue.

Milk, egg, and meat proteins are complete in that they contain all the amino acids required by the human body. Other proteins, such as those derived from vegetables and fruits, are deficient in one or more of the necessary amino acids and no one vegetable or fruit will furnish all of the amino acids required in the metabolism of the body. However, a diet containing a variety of vegetable foods, or one consisting of meat

*Note: An organic acid in which one or more hydrogen atoms have been replaced by the amino group NH_2.

and vegetables, will usually provide all of the amino acids required, as those that are absent from one article of food will be present in another.

Carbohydrate. Carbohydrates are contained in both vegetable and animal food but are derived principally from such articles of food as bread, potatoes, fruits, and cereals.

The oxidation of carbohydrate and fat in the body constitutes the source of power for physical work. Normally about 65 per cent of the energy produced by the body is derived from carbohydrate ingested as food. If more carbohydrate is ingested than is needed by the body, a part of the excess is converted into fat and stored as such in the body. If the food contains an insufficient amount of carbohydrate, there will be a decrease in ability to perform physical work, metabolic disturbances may occur, and body fat and other tissues will be utilized to produce energy. Ingested protein may, to some extent, be utilized by the body to provide energy when the supply of carbohydrate and fat in the food is deficient. However, physical efficiency and body weight are not maintained under ordinary conditions if the diet does not contain sufficient carbohydrate and fat.

As carbohydrate is the principal source of energy (heat and power), the amount required will depend on a number of factors, including the physical activity of the individual, the climatic conditions, the character of the clothing and the body weight.

Fat. Fat is present in varying proportion in most articles of food, but is derived principally from meats, fish, milk and milk products, and vegetable oils, such as olive and cottonseed oil. Like carbohydrate, fat serves as a source of energy, although being less readily digested, absorbed and oxidized, it does not become available as a source of energy as quickly after ingestion.

If more fat is ingested than is needed by the body, some of it will be stored in the tissues where it constitutes a source of reserve energy which is drawn upon by the body when the food fails to supply the required amount of carbohydrate and fat. Stored fat also serves by its presence to protect and to support certain of the organs and other structures of the body.

While lack of sufficient fat in the diet can, to some extent, be compensated for by an excess of carbohydrate, the total absence of fat, or a long continued deficiency, will cause metabolic disturbance and a decrease in physical efficiency. The consumption of an excessive amount of fat will result in an increase in body weight due to the deposition of fat in the tissues of the body and may result in metabolic or digestive disturbances.

Minerals. Certain of the mineral salts are necessary for the normal metabolic processes of the body. They enter into the formation of all the tissues of the body and serve to maintain the proper chemical reaction of the body fluids. The minerals which are present in a satisfactory diet in appreciable quantities are calcium, phosphorus, potassium, sulphur, sodium, chlorine, magnesium, and iron. Other minerals which are essential for metabolism, but which are present in the food only in minute quantities, are iodine, fluorine, and silicon.

Vitamins. Vitamins are substances, present in minute amounts in natural foods and necessary for the maintenance of health and life itself. Their absence causes the onset of certain serious deficiency diseases. At present ten vitamins have been isolated and synthesized in crystalline form. These are Vitamin A, Vitamin B_1 or thiamin, Vitamin B_2 or riboflavin, Nicotinic acid, Panthotinic acid, Pyridoxin, Vitamin C or ascorbic acid, Vitamin D, Vitamn E or tocopherol, and Vitamin K. Many more await discovery.

Only small quantities of vitamins are stored in the body and, as it is improbable that any are produced by the tissues, the vitamin requirement must be met by a supply from without the body, by the vitamins contained in the food.

The vitamin content of a food, particularly vegetables, may be reduced or completely removed by extraction into the cooking water during the cooking process. The water in which vegetables are cooked and the vegetable juices should be saved and utilized as food, in so far as practicable, in order to save all the vitamins possible.

Vitamin A is found in animal and sea foods such as fish liver, eggs and milk. A substance which is changed into Vitamin A in our bodies by an enzyme, is found in milk, cream, butter, lettuce, carrots, apricots, peaches and sweet potatoes. Vitamin A is of particular importance to aviators in night flying and drivers of motor vehicles at night since an early evidence of deficiency is night blindness.

Vitamin B_1, or thiamin is another important vitamin from the military standpoint. Natural sources of this substance are whole grain cereals, bread, leafy vegetables, liver, kidney and others. A deficiency of this vitamin causes the disease known as Beriberi. The disease occurs in all countries where rice forms the stable food as China, Japan, the Dutch East Indies, Brazil, India, the Malay Peninsula and the Philippine Islands. The deficiency is produced by the too exclusive use of rice that has been completely milled and the outer layers, which contain the vitamins, removed. The disease took a dreadful toll of sailors in the Japanese navy and of our own Philippine Scouts till it was discovered that faulty diet was the cause.

Vitamin C is no doubt the most important vitamin from a military standpoint. Scurvy is the disease caused by a deficiency of this vitamin. Scurvy was the principal killer of seamen and has markedly influenced naval history, exploration and colonial expansion. It still attacks our armies and civilian population. It is a potential hazard of great significance in operations in extreme cold.

The citrous fruits and certain vegetables in the raw state, notably onions and potatoes, are extremely rich in this vitamin. The body is not capable of storing it in large quantities so that absence or reduction of it in the diet is soon followed by symptoms of scurvy.

Food Requirements. The total food requirement is usually expressed in terms of calories derived from the nutrient food constituents. This method assumes that the nutrient food constituents, as supplied, will contain the proper kind and an adequate quantity of vitamins and mineral salts, and in stating the value of the diet in calories it is assumed that the diet is balanced in all respects.

The average caloric values of the food constituents within the body, that is, the physiological energy values, are as follows:

Protein, 4 calories per gram, 1,814 per pound.
Carbohydrate, 4 calories per gram, 1,814 per pound.
Fat, 9 calories per gram, 4,082 per pound.

The Food Allowance. In feeding troops consideration must be given to factors which render it necessary to increase the quantity of food provided beyond that which will, theoretically, meet their metabolic requirements. The food allowance must always be greater than the theoretical food requirements. The quantity and character of the food consumed by troops under average service conditions will vary within limits with the nature of the work, the manner and methods of preparing and serving the food, the dietary habits of any considerable proportion of the group concerned, the variety of the food articles served, and variations in climatic conditions. Increased physical activity will render additional food necessary to supply the increased energy demand. A poorly balanced diet may result in the decreased consumption of one food constituent with an increased consumption of others or a decrease in the total food intake.

Changes in the occupational environment may modify the food allowance. Recruits, as a rule, will eat more food than trained troops until they become accustomed to the physical activities of the military service. Troops in the field who are subjected to cold or rain will require a larger allowance of food than those in permanent stations or camps.

The food allowance for troops must also provide for a certain amount of wastage, which, even though it is small in well operated messes, always occurs in some degree.

Any diet, in order to be balanced, must primarily contain an adequate quantity of each of the five food constituents, that is, protein, fat, carbohydrate, vitamins, and mineral salts. It is not necessary, nor is it practicable, to prepare each meal or the ration for each day so that the food constituents are balanced, but the food consumed during a given period of time, for example one week, should constitute a balanced diet.

Diseases Caused or Transmitted by Food. The diet may be the primary cause of a disease either because it fails to supply or provides only an inadequate quantity of a food constituent, or the food may serve as a transmitting agent for the causative organisms of certain of the infectious diseases.

Those diseases which are produced by a deficient diet are classified generally as deficiency diseases. They are caused by the lack of an essential food factor and are preventable and curable by a balanced diet.

Any disease, the causative organisms of which can be conveyed by the food to a point of invasion within the body, may be transmitted by food. The diseases most frequently transmitted in this manner are those belonging to the intestinal group, such as typhoid fever, the food infections, dysenteries and diarrhoeas, but food may also be the transmission agency for other diseases, such as tuberculosis, scarlet fever, and diphtheria.

Poisoning may be caused by certain plants of which mushrooms, or rye contaminated with ergot are examples. Poisoning may also result from the ingestion of food containing chemical poisons. Cases of poisoning have resulted from the use of silver polish containing sodium cyanide. At times roach powder may be carelessly included in the food. Utensils plated with certain substances as cadmium can produce food poisoning particularly if acid foods are kept in them.

Contaminated food is food which contains pathogenic organisms or the toxic products of such organisms. Food products may be unsuitable for consumption because of contamination with pathogenic organisms or their products, spoilage, the presence of chemicals, or inherently poor quality.

Where food is contaminated prior to cooking, the cooking processes to which it is subjected may, and frequently do destroy the disease producing organisms or toxins and render the food safe for consumption.

Prevention of Disease Transmission by Food. The prevention of disease transmission by food is accomplished by adequate and timely inspection of food products and the rejection of those unsuited for consumption, and the employment

of facilities and procedures in the handling, preparation and serving of food which will obviate contact with infected materials or contamination with pathogenic organisms.

The food products that are routinely inspected for the purpose of detecting conditions which render them unsuitable for food are: Meat and meat products; poultry and eggs; fish and shellfish; milk and milk products; canned foods; fresh vegetables and fruits.

Ordinarily, such foods as sugar, cereals, salts, or spices are not inspected for deficiencies which would impair health.

Food handlers often serve as agents in the transmission of disease. Their control through physical examinations, frequent inspections and close supervision to ensure clean habits and good health, is a necessary measure in cutting down the incidence of respiratory and intestinal diseases.

Protection and Storage of Food Supplies. Surplus and reserve food supplies should be protected from insects such as flies and roaches, from dust and dirt, and from rats and mice. Perishable foods should be stored at a temperature which will inhibit the growth of moulds and bacteria. For camps of less than one week's duration, storage devices for preservation of food are of necessity. For longer periods satisfactory storage methods are required.

In temporary camps food may be stored in watertight containers and immersed in springs or streams, care being taken to prevent contamination. Food may be buried below the surface of the ground where the temperature is lower, lining the pit with burlap and placing boards on the bottom. In addition, food containers suspended from trees or tripods and underground ice boxes provide satisfactory means of protecting and storing food.

A suspended food container (Fig. 14) consists of a screened box that permits free circulation of air but prevents contamination by insects. The cooling effect is increased by wrapping the box in burlap which is kept damp. Fresh meat, bottled milk, and vegetables may be temporarily stored in such a container. It should not be used where the air contains any considerable amount of dust.

The underground ice box or cooling box (Fig. 15) is a simple device consisting of a double walled box which may be made by placing one packing box within a larger one and sinking it into a pit in the ground so that the outer lid is slightly above the surface of the ground. A space three to six inches wide, filled with sawdust, grass, hay or straw should separate

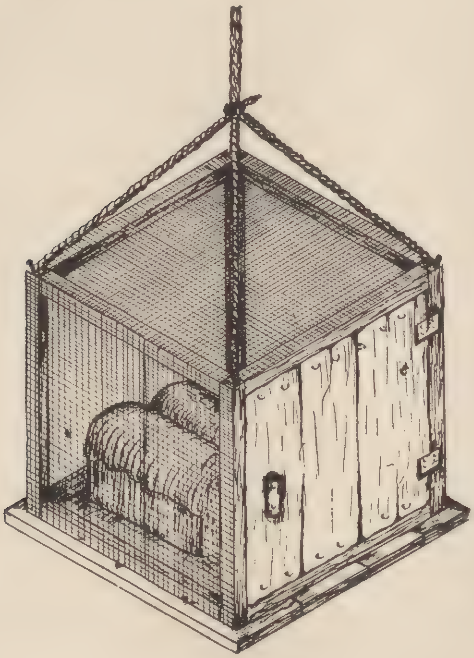

Fig. 14. Suspended food container. (From Dunham's Miltary Preventive Medicine, 3rd Edition).

the outer walls and the two bottoms. Two lids are necessary, one for the inner and one for the outer box. A drainage ditch should be dug around the box and a drain pipe should lead through the bottom of the box to a small soakage pit below. A box four feet long, three feet wide and three feet deep, inside measurements, has sufficient capacity for the average company mess. If ice is available, an ice compartment should be constructed at the end containing the drain pipe. The box

may be used above the ground as an ice box. The cooling effect is increased by dampening the packing material between the walls or wetting down the earth around the box To facilitate cleaning, the inner box should be easily removable. Meat, milk, vegetables, or other perishable foods may be stored in such a box.

In semi-permanent camps fresh or cured meats, milk and vegetables should be kept in underground storage rooms constructed similarly to an old-fashioned root-cellar (Figs. 16 and 17). The floor should consist of well tamped earth or boards. The walls should be boarded. Ventilation should be secured by windows at the ends or by an outlet through the roof. Vegetables should be kept in vegetable bins (Fig. 18). These bins are made of spaced slats to permit the circulation of air. The bottom should slope sufficiently to permit the older vegetables to be used first.

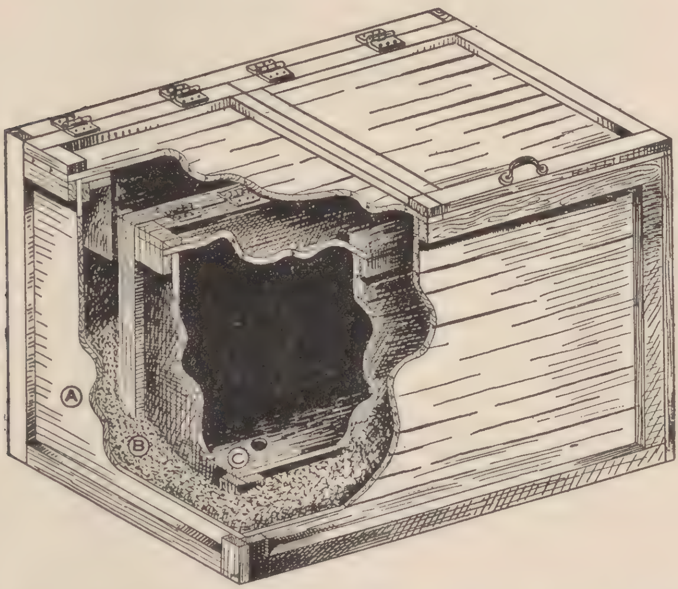

Fig. 15. Underground ice or cooling box. A—Outer wall. B—Insulating material. C—Inner wall. (From Dunham's Military Preventive Medicine, 3rd Edition).

Canned goods should be kept in storerooms adjacent to kitchens. Bread boxes, which permit aeration of the contents, should be used.

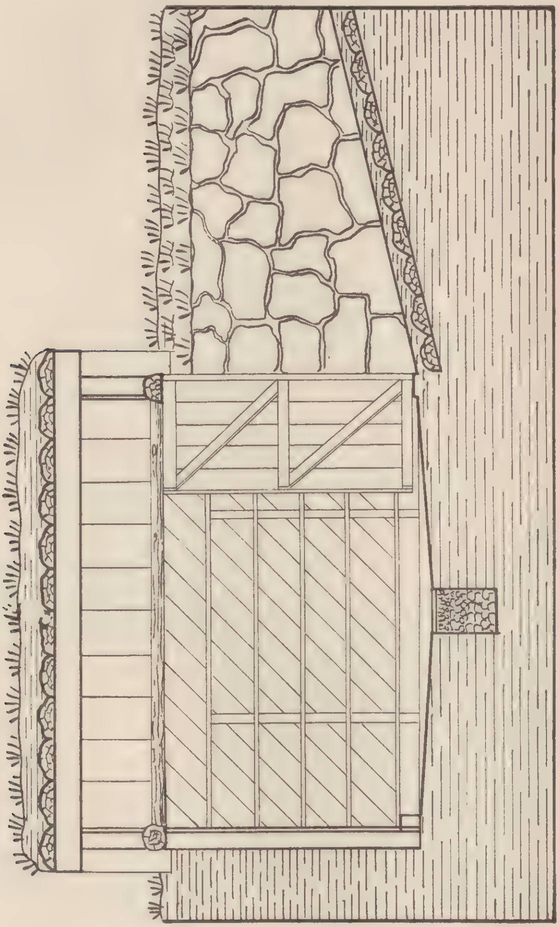

Fig. 16. Underground storeroom, longitudinal section.

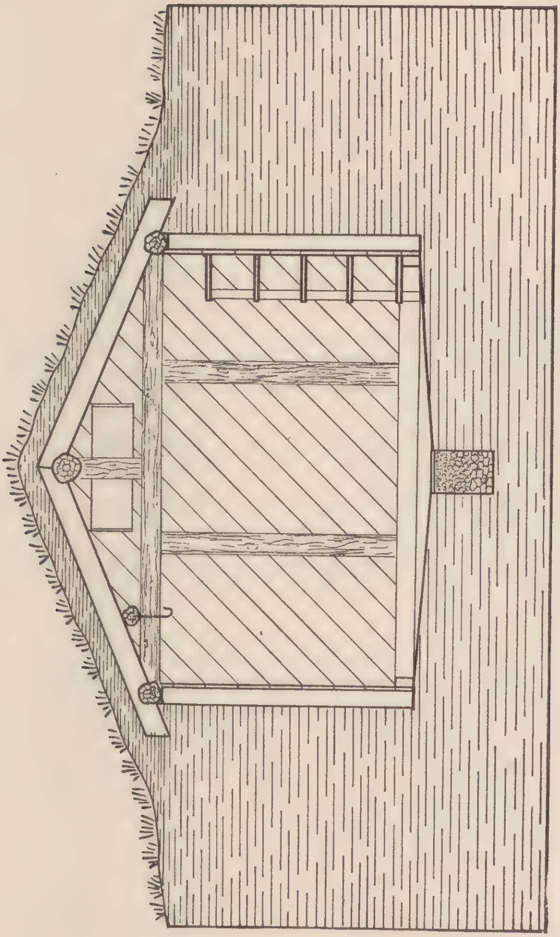

Fig. 17. Underground storeroom, cross section.

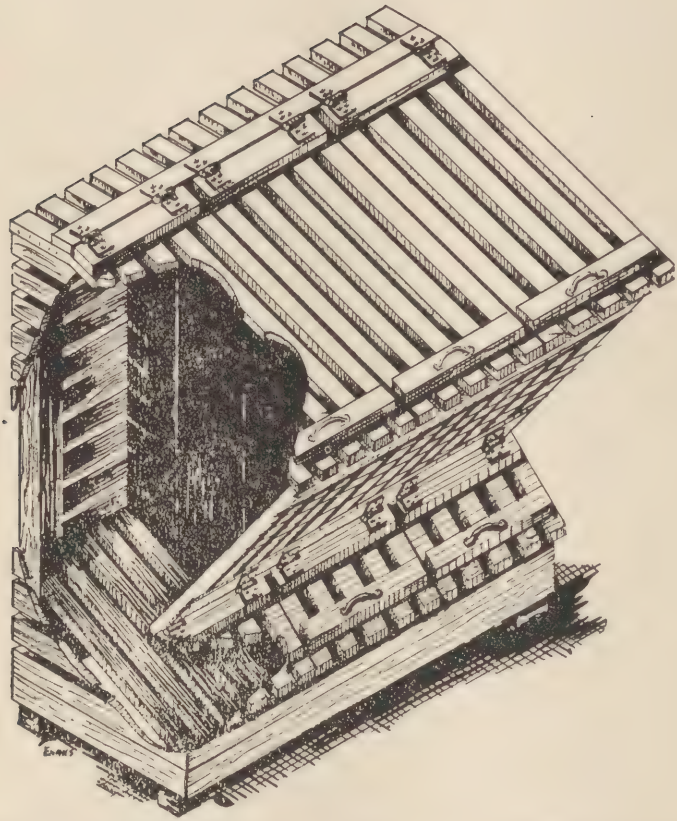

Fig. 18. Small vegetable bin. (From Dunham's Military Preventive Medicine).

CHAPTER IX.

WASTE DISPOSAL

The disposal of waste materials in such a manner that they are eliminated as factors in the spread of disease is an essential feature of health work. Wastes which are factors in the spread of diseases are: Human wastes (feces and urine); kitchen waste (garbage); animal waste (manure); rubbish.

Disposal of Wastes in the Field. Human wastes. Human wastes play a most important role in the transmission of intestinal disease since they so frequently are carried into waters which are used for drinking and cooking purposes and conveyed to food by the hands, by flies and other insects, and by rats and mice. The harmful effect of improper disposal of human wastes tends to increase in bivouacs and in temporary or semi-permanent camps. Important general principles in the disposal of human wastes under these conditions are:

(1) Latrines are installed and maintained by the personnel of the unit using them.

(2) Seats or spaces are provided at the latrine to accommodate 8 percent of the command at one time. Each seat or space requires 2 feet of length of latrine trench.

(3) Latrines should be fly-proofed.

(4) Latrines should not be dug below the level of ground water.

(5) Clay soils are unsatisfactory for latrines since liquids will be poorly absorbed.

(6) Latrines should be placarded when closed, if the military situation permits, showing the date and organization.

(7) Latrines should be located about 30 yards from the end of the company street, and at least 100 yards from any mess, with an eye to the avoidance of any possible drainage into any nearby source of water supply.

(8) A lighted lantern should mark each latrine at night unless the military situation prohibits the use of lights.

The types of latrines used in temporary and semi-permanent camps differ in construction but their care is similar. They should be dug immediately after a command halts or goes into camp and closed just prior to departure.

The Cat-Hole Latrine. The "cat-hole" latrine is used on a march at the hourly halt. A soldier desiring to relieve himself digs a small hole with an entrenching tool, a pointed stick or sharp stone, deposits his dejecta therein and backfills the hole with the excavated earth. Urine is disposed on the ground in a secluded spot.

Straddle Trench Latrines. Straddle trench latrines are used for the disposal of feces and urine in bivouac, in camps of less than one week and at the noon halt on a march. They may also be used in camps of more than one week duration until deep pit latrines can be constructed. This latrine is usually constructed by digging a trench 1 foot wide, 2 feet deep and 8 to 10 feet long. Sometimes, it may be desirable to dig small units of trenches, each 2 or 4 feet long. In either event the total length of trench should be such as to accommodate 8 percent of the command at one time. The earth removed should be piled at one or both ends of the trench. To use a straddle trench latrine a man squats astride the trench. Care should be exercised that men do not squat in front of the trench as this procedure will foul the earth along the sides of the pit. After use each man is required to cover his excreta and the used toilet paper with some of the excavated earth. This trench is also used as a urinal. Boards placed along the edges of the trench provide better standing. Toilet paper should be available and protected from the elements. An entrenching tool or "spade-like" board should be placed in each pile of excavated earth. (See Fig. 19)

When the straddle trench latrine is filled to within 1 foot of the ground surface, the interior of the trench and the contents should be thoroughly sprayed with crude oil, and the trench closed by backfilling with earth. The earth should be domed 12-18 inches above the surrounding ground surface.

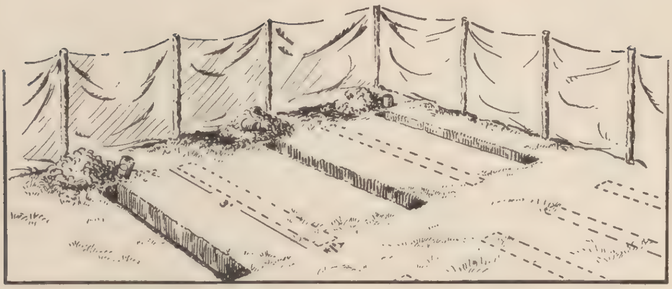

Fig. 19. Trench latrine with canvas screen.

Deep-Pit Latrines. When troops are in camp one week or longer, deep pit latrines with urinal troughs or urine soakage pits are constructed. These devices may be used in camps of a more permanent nature. The deep pit latrine is used in conjunction with the standard quartermaster latrine box and must therefore be dug to exact dimensions to conform to the size of the box.

The latrine pit is dug 2 feet wide, 8 feet long and to a depth depending on the character of the soil and the length of time the latrine is to be used. The rule for depth is to allow 1 foot for each week the latrine will be in use and to allow an additional 2 feet for backfill and cover. For example, if a latrine is to be used for three weeks, it should be dug 5 feet deep; if for six weeks, it should be 8 feet deep. An underlying strata of rock or ground water may limit the depth of the latrine. A company of 200 men requires 32 feet of latrine space and four standard 4-hole latrine boxes. (Fig. 20).

Pit latrines must be fly-proofed to prevent access of flies to fecal material and to prevent the escape of larvae in case flies have gotten into the pit and breeding has taken place. Fly-proofing is accomplished in the following manner: An area 4 feet wide surrounding the pit is excavated to a depth of 6 inches. This area is then covered with burlap and soaked with crude oil. This burlap hangs down the walls of the pit to a depth of 18 inches and is turned down into the ground at the outer borders of the excavated area. The earth is replaced,

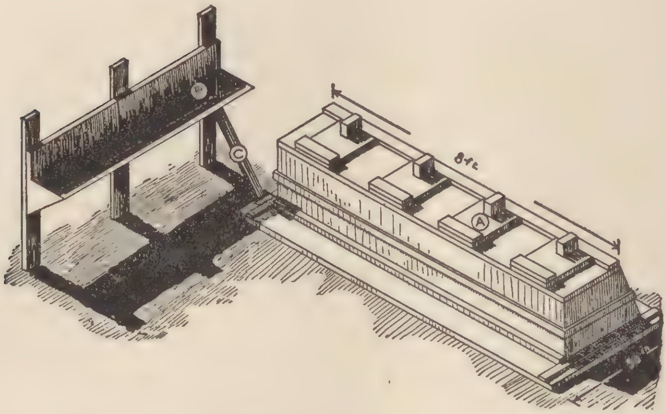

Fig. 20. A—Standard latrine box. B—Trough urinal. C—Pipe from urine trough to latrine pit. (From Dunham's Military Preventive Medicine, 3rd Edition).

tamped down and more oil is added. If burlap is not obtainable, oil alone may be used. If oil is not available, the earth may be hardened by moistening with water and tamped into place (Figs. 21 and 22). Care should be exercised to tightly pack the earth around the edges of the box to seal all openings to the pit.

When the fly larva has reached its full development it leaves the moist material in which it has grown and seeks dry, loose earth in which to pupate. In a latrine pit, prepared as described above, access of the larvae to a place favorable for pupation is obstructed by the burlap sacking and the compact oil-soaked earth.

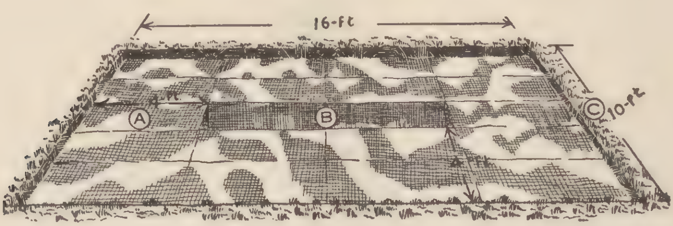

Fig. 21. Method of flyproofing latrine, A—Oil soaked burlap extending completely around pit. B—Opening of pit. C—side wall of excavation in which burlap is placed. (From Dunham's Military Preventive Medicine, 3rd Edition).

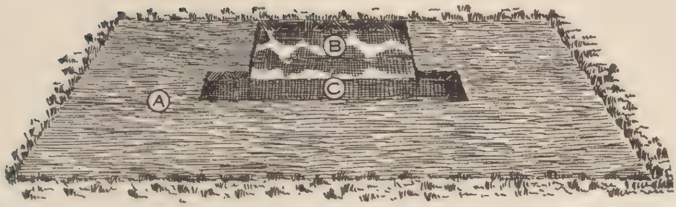

Fig. 22. Method of flyproofing latrine, A—Layer of earth replaced and tamped down over burlap. B—Oiled burlap exposed before replacement of earth. C—Opening of pit. (From Dunham's Military Preventive Medicine, 3rd Edition).

The Urinal Trough. If a deep pit latrine is dug in ground with high absorbent qualities a urine trough should be used in conjunction with the pit. The trough then drains into the deep pit latrine and is included within the latrine enclosure. This trough is constructed from tin, galvanized iron or wood. When made from wood it should be lined with tar paper. The trough should be U-shaped and 5 feet in length (see Fig. 20). It is connected to the pit by a short section of pipe.

Urine Soakage Pit. When a deep pit latrine is dug in ground having poor absorbing qualities, a urine soakage pit should be constructed for the disposal of urine. This device consists of a pit 4 feet square and 4 feet deep, which is filled with pieces of broken rock, flattened tin cans, brick or broken bottles. Two square ventilating shafts 4 to 6 inches in diameter minimize odor production. They should extend from about 1 foot above the surface to within 6 inches of the bottom and should have a number of holes on all sides. The top of the shaft should be covered with fine screening to prevent ingress of flies. Urinals made of 2 inch pipe are placed at each corner of the pit extending 8 inches below the surface and 30 inches above. The pipes should incline about 30° away from the vertical. A tar paper funnel containing grass or straw is placed in the upper end of each pipe.

Important precautions in the proper operation of such a soakage pit are the changing of the grass or straw in the funnels daily, cleansing the funnels daily with soap suds,

changing funnels weekly, and keeping the pit surface free from debris. Oil should never be used on a soakage pit as it clogs the pit and makes it useless. Such a pit should serve 200 men indefinitely. When it is closed the pipes should be removed and the pit covered with dirt and sod. The soakage pit may receive urine from a trough urinal located within the latrine enclosure, the pit itself being outside the enclosure.

Location of latrines. Latrines should be located 100 yards from any company mess, any well or spring, and either at the end of the company street or on the flank at the rear of the tents. If nearby ground water supplies are being used for

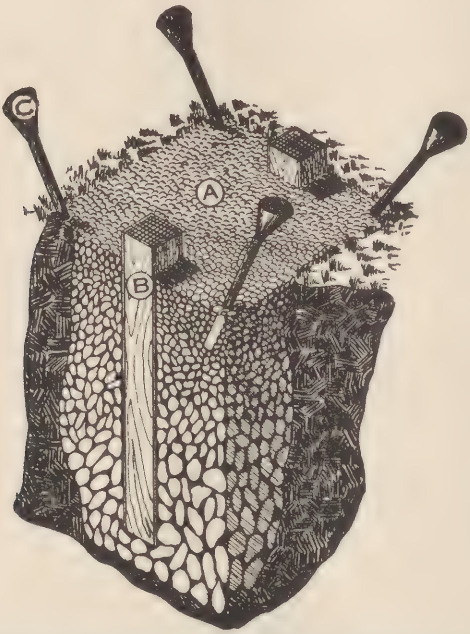

Fig. 23. Urine soakage pit. A—Rocks filling pit. B—Ventilator shaft. C—Pipe urinals. (From Dunham's Military Preventive Medicine 3rd Edition).

cooking or drinking purposes, the latrines should be situated to prevent drainage into the water source.

Care of latrines. Latrines must be kept clean and free from odors and flies. Crude oil or a mixture of crude oil with

fuel oil or kerosene applied to the interior of pits and boxes is of value in eliminating odors and repelling flies. Special attention must be given to the cleanliness of urine troughs. The burning out of latrine pits is not advisable since it does not accomplish incineration of excreta and does interfere with the measures taken for prevention of fly breeding. Lime is of no practical value in latrine pits except as a deodorant.

A latrine orderly should be on duty throughout the day. The contents of the pit, the sides of the pit, and the interior of the box should be sprayed daily with crude oil, using a knapsack spray. The box should be scrubbed daily with soap and water, and twice a week the seats should be scrubbed with 2 per cent cresol solution. Fig. 24 illustrates a brush to be used for this

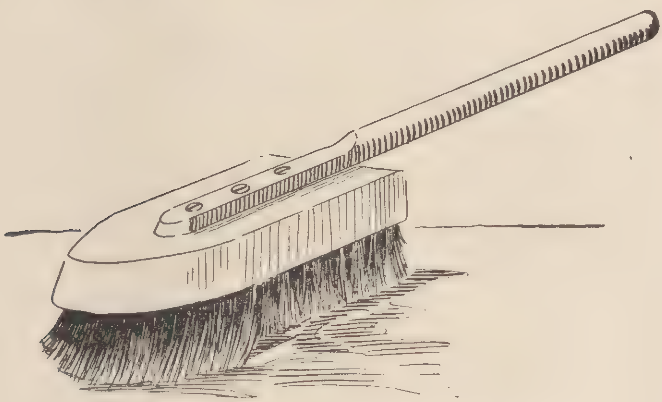

Fig. 24. Brush for scrubbing latrine seats.

supply of toilet paper should be available. The latrine should be enclosed by a canvas screen or a large wall tent may be used; if this is not available, a brush screen may be used. A drainage ditch, 6 inches deep, should be dug outside the latrine enclosure to carry surface water away from the pit.

Deep pit latrines should be closed when filled to within 2 feet of the surface. The box should be removed; the pit contents sprayed with crude oil and covered with burlap, when available; and the pit filled with dirt domed 12 inches

above the surface. The site should be placarded with the date of closure and name of the organization, if military conditions permit.

Pail latrine. If the character of the soil or any other reason makes it impracticable to dig pit latrines, pail latrines may be used. By placing hinged doors on the rear of and a floor in the standard latrine box, it may be used as a pail latrine (Fig. 25). The pail is placed directly below the seat and, if located in a building, the hinged doors should open directly to the outside. The latrine seats and rear doors should be self closing and the box made as nearly fly proof as possible. The floor should be waterproofed, concreted if practicable,

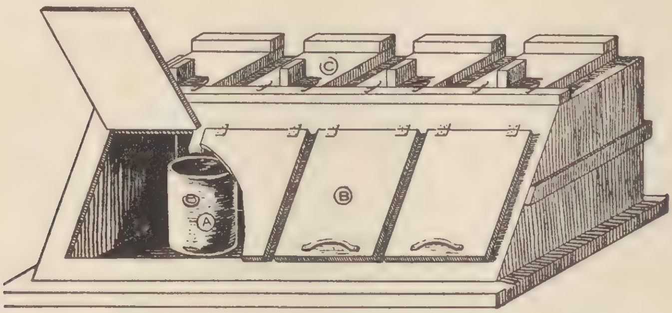

Fig. 25. Pail latrine made from standard latrine box. A—Latrine pail. B—Hinged doors. (From Dunham's Military Preventive Medicine, 3rd Edition).

and have sufficient slope to promote rapid and thorough drainage of the wash water. A trough urinal may be installed within the latrine building with a drain pipe leading into a container outside the building. The pails must be removed and emptied daily, being replaced by clean pails, the bottoms of which should contain about 1 inch of a 2 per cent solution of cresol. The latrine box must be cared for as described under deep pit latrines. The disposal of the excreta from pail latrines may be accomplished by burial or incineration. It may be possible at times to empty the pails into a manhole of a nearby sewer.

Night urinal cans. If the distance to the latrines is considerable, a large can or pail containing 1 inch of 2 percent cresol solution, should be placed at the end of each company street at night, for use as a urinal. Each morning the contents of the cans should be poured by the latrine detail into the latrines or soakage pits and the cans should then be thoroughly washed with hot soapy water.

Kitchen wastes. These are the food remnants accumulated after meals and in the preparation thereof, and the water in which kitchen utensils and mess gear have been washed. The amount of kitchen wastes varies considerably, especially the liquid. However, solids average about ½ pound per person per day and liquids in the amounts of 200 to 1,000 gallons are generally obtained from a company of 200 men. These wastes must be so disposed of as to prevent their giving rise to offensive odors and attracting flies and rats to the mess area. Solid kitchen wastes may be disposed of relatively easily but the disposal of liquids becomes increasingly difficult as larger quantities of water are used. For camps of short duration, one night to a few days, both liquids and solids may be disposed of by burial, either in deep pits or in trenches about 3 feet deep. Where livestock or wild animals are likely to dig up the garbage, it should be buried much deeper and covered with rocks or timber. Trenches should be domed to a height of 12 to 18 inches above the ground level."

Garbage may be disposed of by contract, sale or gift. It may be used on military reservations as food for hogs. Its disposal by contract to civilians may lead to insanitary conditions about a camp through spillage in transfer from garbage cans to other containers, leakage of containers, failure of collection, and unsatisfactory cleaning of cans. When thorough cooperation with the contractor can be maintained so as to insure cleanliness in the procedure, there is no objection to this method of disposal. However, the site of final disposition, the place where the garbage is fed to hogs, should be far enough removed from the camp that odors and flies will not become a nuisance.

When garbage is to be used as food for swine, it is necessary to separate it into edible and non-edible portions and the latter should be disposed of by incineration. It is necessary also to take considerable care that substances harmful to hogs do not get into the edible portions. Lye and bits of broken glass are especially injurious to hogs.

Except when it is disposed of by burial, it is desirable that garbage be separated into liquid and solid portions by passing it through a drainer such as is shown in Fig. 26.

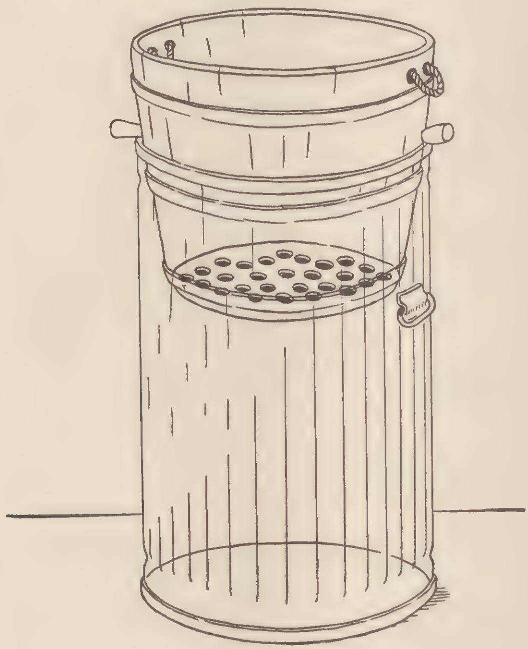

Fig. 26. Garbage drainer.

Liquid waste. Liquid kitchen waste is best disposed of through soakage pits (Fig. 27). A soakage pit is constructed by digging a hole 4 feet deep and 4 feet square and filling it with broken rock, the larger size, 3 inch, towards the bottom, and the smaller, 1 inch toward the top. Crushed tin cans,

broken bottles, broken brick, broken concrete or pine knots may be substituted for the crushed rock. Ventilating shafts similar to those used in a urine soakage pit are recommended. Two such pits should be constructed for each company mess and used on alternate days, if the camp is to last several weeks. In camps of long duration each soakage pit should be given a rest period of one week every month. When the pit becomes foul, the application of 5 gallons of 10 percent solution of calcium hypochlorite or of caustic soda may clear

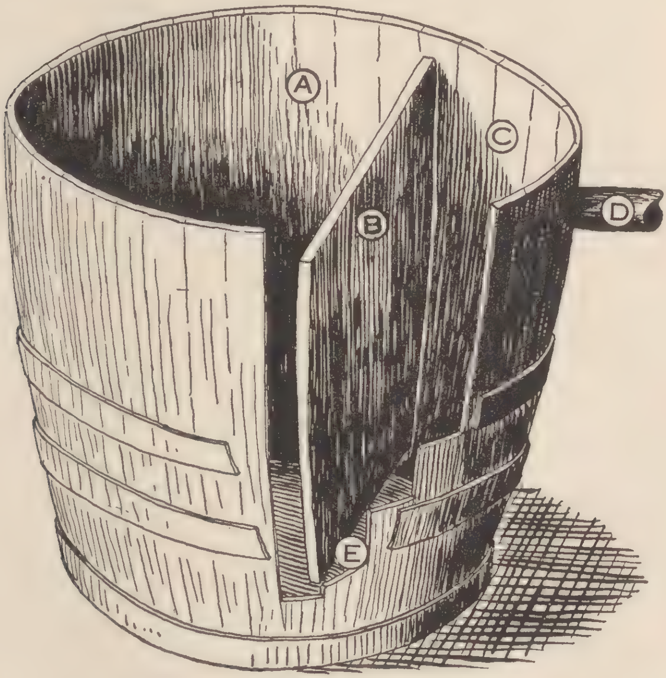

Fig. 27. Baffle grease trap made from a half barrel, A—Influent chamber. B—Baffle. C—Effluent chamber. E—Passage under baffle. D—Effluent line. (From Dunham's Military Preventive Medicine.

it. Soakage pits should be located near the kitchen if suitable soil is present. Otherwise they should be situated where satisfactory drainage can be found.

Before being placed in the soakage pit, the water must

be passed through a grease trap to remove food particles and as much grease as possible; otherwise, the side walls of the pit soon become coated with grease and debris and the leaching of water into the soil is prevented.

The cool water grease trap (Fig. 28) is made of a half barrel divided into unequal chambers by a wooden baffle extending to within one inch of the bottom, the larger chamber, two-thirds of the barrel, being the influent and the smaller the effluent chamber.

Fig. 28. Ash barrel grease trap.

The trap is provided with a hinged removable lid and inserted into the lid of the influent chamber is a metal strainer 8 inches square and 6 inches deep, the bottom of which contains many perforations and which is filled with straw to prevent the

coarser solids from entering the trap. The strainer is made removable to facilitate cleaning. A 1-inch pipe is inserted in the upper third of the effluent chamber leading to a U-shaped trough which carries the effluent to the soakage pit. In operating the trap, both chambers are filled with cool water. The warm kitchen liquid waste strikes the cool water in the influent chamber, the grease rises to the surface and is prevented by the baffle board from reaching the outlet to the soakage pit.

Meticulous attention is necessary in order to prevent such a trap from becoming a nuisance. The trap should be drained daily, the sediment removed and burned and the trap, including the removable strainer, thoroughly cleaned with soap and water. Instead of using a barrel, the trap may be built as a rectangular box.

An ash barrel grease trap, is prepared as follows: Using a barrel of about 50-gallon capacity and with one head removed, bore thirty ¾ inch holes in the remaining head. Place about 8 inches of gravel or stone in the bottom, the size of the stone decreasing from one inch at the bottom to ¼-inch at the top, and over this place 16 inches of wood ashes. Fasten a piece of burlap over the open top of the barrel by means of a hoop. The trap may be placed directly on the soakage pit or on an impervious platform which drains into the pit. The sullage water is poured into the barrel through the burlap, food particles thus being strained out. As the greasy, soapy water filters through the ashes the greater part of the grease and soap will be removed. The burlap should be removed daily and burned. It will be necessary to replace the ashes every three or four days (Fig. 28). Ashes removed should be buried."

Soakage Trenches. When a rock stratum or ground water is encountered near the ground surface, one or more soakage trenches may be used instead of a soakage pit. The trench consists of a central pit 2 feet square and 1 foot deep with arms 6 feet long extending outward from each corner of the central pit. These arms are 1 foot wide and 1 foot deep where they leave the pit, sloping to a depth of 18 inches at their outer extremities. The central pit and the arms

are filled with contact material of crushed rock, brick, broken concrete, bottles, crushed tin cans, etc. A grease trap must also be used with this soakage trench. (Fig. 29)

When more than 200 gallons of water per day are to be disposed of, additional soakage pits and grease traps are necessary. When the quantity is in excess of 500 gallons per day, a different procedure is advisable.

Up to 10,000 gallons of water may be disposed of by the construction of a combined grease trap and settling basin, the size of which will be determined by the volume of water used (Fig. 30). For handling 10,000 gallons of water the tank should be 25 feet long, 8 feet wide and 5 feet deep, divided into two unequal portions by a wall located 5 feet from the inlet end. In the smaller compartment, 5 x 5 x 10 feet, there should be a baffle wall 2 feet from the inlet and extending to within 6 inches of the bottom. The smaller compartment

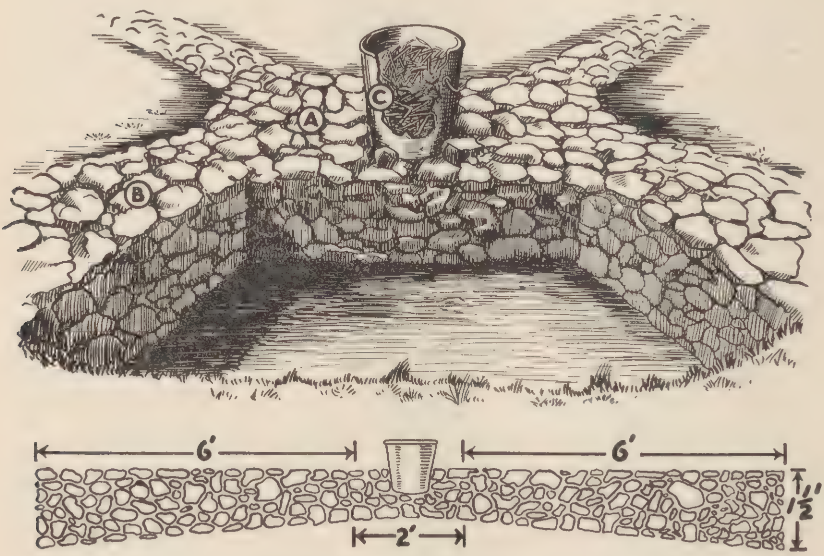

Fig. 29. Soakage trench. A—Central square area; B—Radiating lateral trenches; C—Pail grease trap. (From Dunham's Military Preventive Medicine, 3rd Edition).

forms a grease trap while the larger compartment acts as a settling basin and when built of this size, 5 x 8 x 20 feet, will hold 5,000 gallons of water, so that there will be a retention period in the tank of about 12 hours. The inlet line should be 4 inches in diameter and located in the end wall one foot below the top of the tank. The outlet for the grease trap proper

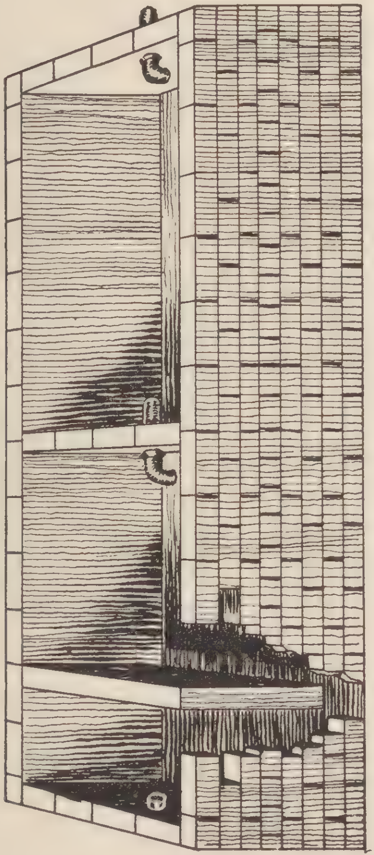

Fig. 30. Combined grease trap and settling basin.

to the settling tank should be of the same diameter and similarly located. The inlet and outlet should be submerged.

That portion of the tank which forms the grease trap consists of two compartments separated by the baffle. Water entering the trap, passes under the baffle into the large compartment, the grease floating to the surface in the first compartment whence it is skimmed off daily and burned.

In the larger portion of the tank, 5 x 8 x 20, the detention period is sufficient to bring about a fairly complete settling of all suspended matter and the water leaving it may be disposed of satisfactorily, in a stream, provided the flow of the stream is at least 500,000 gallons per day. If the stream available is small, so that emptying this water into it will lead to a nuisance,

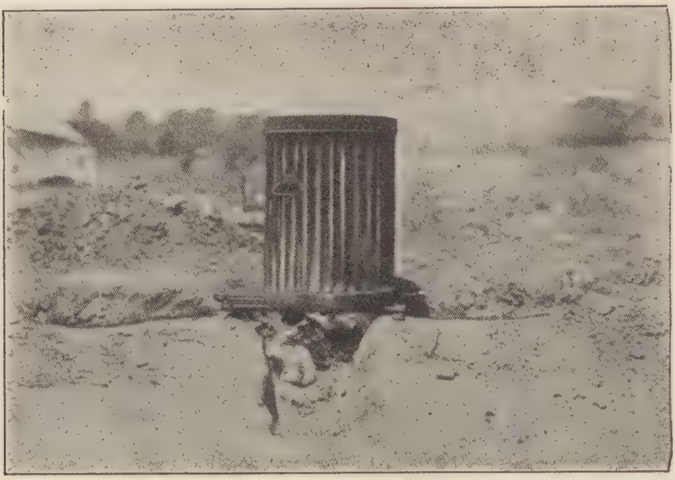

Fig. 31. Barrel and trench incinerator. Barrel made from galvanized iron garbage can from which the bottom has been removed. (From Dunham's Military Preventive Medicine, 3rd Edition).

or if there is no stream at all, the water may be disposed of by sub-surface irrigation.

If the ground is impervious, water can escape only into the top soil where it must be disposed of chiefly by evaporation, since sub-surface disposal cannot be used.

Solids. In temporary camps solid wastes are best disposed of by incineration by individual companies. The incinerator of choice is the barrel and cross trench incinerator which is built, operated and maintained by the unit using the device.

A cross trench incinerator is constructed by digging two trenches 8 feet long, 1 foot wide, crossing at right angles at their centers. Each trench slopes from ground surface at the outer end to a depth of 18 inches at the center of the intersection. Place pieces of scrap iron across the trenches where they intersect to act as a grate and as a support for an old galvanized iron can, the bottom of which has been removed. The can is placed over the intersection of the trenches (Fig. 31). Such an incinerator is satisfactory for camps of a month or less. For longer periods build an incinerator on the same principle but use stone or brick instead of the galvanized can and cover the outside with puddled mud or clay. Another type of incinerator may be built by setting a barrel, both ends of which have been

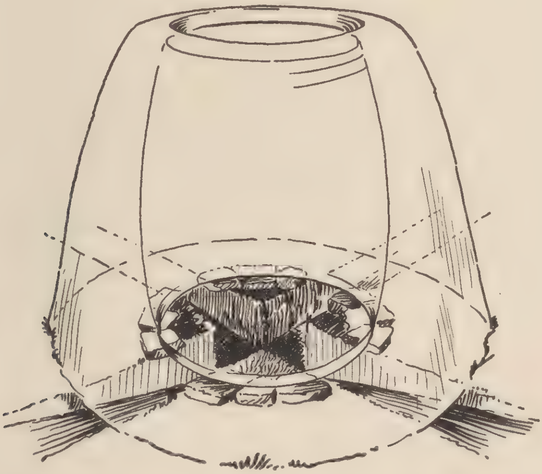

Fig. 32. Barrel and trench incinerator using barrel of wood covered with clay (schematic).

removed, over the intersection of the trenches and covering the outside of the barrel with a layer of clay which has been wet sufficiently to mould well (Figs. 32 and 33). The layer of clay should be about 6 inches thick at the top of the barrel and about 8 to 10 inches thick at the bottom. A slow fire is kept under the barrel for several hours to slowly bake the clay. When the clay has baked, a brisk fire is built to burn out the barrel and the barrel is ready for use. Carefully built, such an incinerator will last several weeks. Cross trench incinerators work better when three of the trenches are closed off, leaving the one open toward the direction from which the wind is blowing. Properly fitted pieces of tin may be used to close the trenches. The incinerator should be stoked from the top only, the rubbish, flattened cans and wood mixed with the drained garbage acting as fuel and serving to keep the burning mass loose.

Fig. 33. Barrel and trench incinerator. Barrel made from packed clay moulded over wooden barrel. (From Dúnham's Military Preventive Medicine, 3rd Edition).

An inclined plane incinerator such as is shown in Figs. 34 and 35 will probably be more satisfactory than a cross trench incinerator in semi-permanent camps. In such an incinerator, the garbage is fed into the upper end of an incline and is gradually pushed down to the lower end, drying and burning as it progresses, final combustion taking place on a

grate at the lower end. The incline is closed over so as to retain the heat and direct it to the mass of drying garbage. In the incinerator shown in the figure, the incline is made of corrugated iron resting upon a rock bed and is covered over with portions of steel oil drums. There is a loading and stoking area at the rear and a grate area at the front. The stoking area is closed over with a hinged iron cover, a vent 5 x 16 inches for draft being left at the outlet of the incline and the grate covered

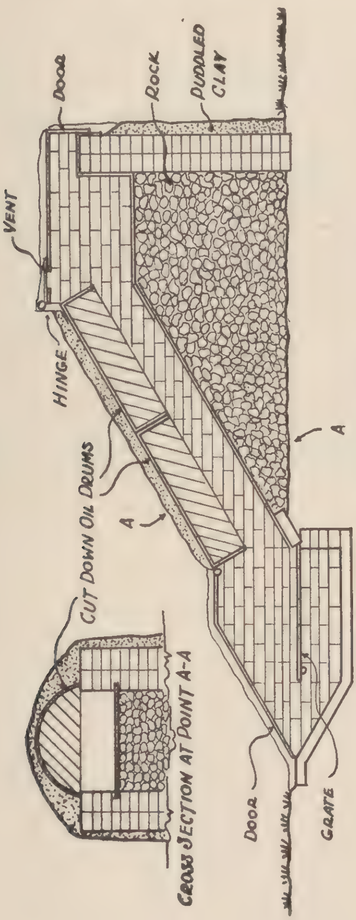

Fig. 34. Incline plane incinerator.

with a door which may be opened as desired for draft.

The walls of the incinerator may be laid up with stone, brick or concrete. Sections of two oil drums are used to form the cover, the drums being cut longitudinally four inches above the center, the smaller sections used, the ends being left in place. These sections are placed end to end and supported on the sidewalls eight inches above the inclined floor. Puddled clay is placed over the oil drums to a depth of two inches.

In use, a fire of wood and rubbish is built on the grate

Fig. 35. Incline plane incinerator.

and after the incinerator becomes hot a canful of drained garbage is emptied on the stoking area, some being pushed part way down the incline. As the garbage dries on the incline it is pushed farther down until it burns, being replaced by other garbage from the stoking area. The cover over the stoking area serves to retain heat, so that considerable drying and even burning takes place. The ends of the sections of oil drums serve as baffles which give rise to swirling of the burning gases and apparently aid greatly in the drying and combustion.

Animal Waste. Manure. Consideration of the disposal of horse manure is important to troops in the field as it

affords a breeding place for flies. The amount of manure to be disposed of averages 10 pounds per animal per day if animals are on a picket line and 25 pounds if the animals are kept in stables. Manure from a picket line of a week's duration may be scattered and dried by sunlight. Its depth must not be greater than four inches. If the camp lasts more than one week other methods of disposal must be selected. The approved method of disposal is either by contract or by composting. If by contract, care must be taken to see that the manure is properly collected and transported and finally disposed of far enough away from camp that a fly menace will not occur. Disposal by composting is recommended in semi-permanent camps (see fly control, page 000). In temporary camps manure may be disposed of by burning but enormous amounts of wood and oil are required unless the manure is thoroughly dried beforehand.

Manure which has been properly composted and is 1-½ to 2 years old should be used for fertilizer. Such manure will not serve as a breeding place for flies.

Rubbish. Accumulations of rubbish attract flies and rats which in turn act as the transmitting agents of certain diseases to which man is susceptible. All rubbish, not garbage, should be collected daily in gunny sacks which are placed on poles at both ends of the company street and in latrines. It should then be transferred to company incinerators and burned. In semi-permanent camps it may be disposed of on a dump, being burned there daily.

Waste Disposal at Stations. Waste disposal in permanent stations is generally not a difficult procedure. The Corps of Engineers is responsible for the construction, operation and maintenance of all permanent facilities and installations utilized for waste disposal. The Medical Department is responsible for the sanitary supervision pertaining to the construction and operation of all facilities and installations employed for the disposal of those wastes which are directly or indirectly concerned in the transmission of disease.

Human wastes are disposed of through proper plumbing fixtures which ultimately empty into sewage disposal plants.

Liquid kitchen wastes are disposed of in a similar manner and solid wastes are disposed of by selling, feeding to hogs, and incineration. Animal waste (manure) is disposed of by composting. Rubbish is collected and all combustible portions are burned and non-combustible portions disposed of on dumps. Tin cans or other containers which will hold water should be burned, then flattened so as to prevent their acting as breeding places for mosquitoes.

The proper collection of garbage at a permanent station is a matter of concern to all officers. Garbage must be placed in suitable receptacles. Ordinarily galvanized iron cans equipped with tight-fitting metal lids are available for this purpose. The garbage must be separated from the rubbish and classified on a basis for its utilization as animal food. Classification also serves as a check on the waste of food and facilitates disposal either by feeding to hogs or by incineration. The different classes of garbage should be placed in separate cans and plainly labeled (Fig. 36).

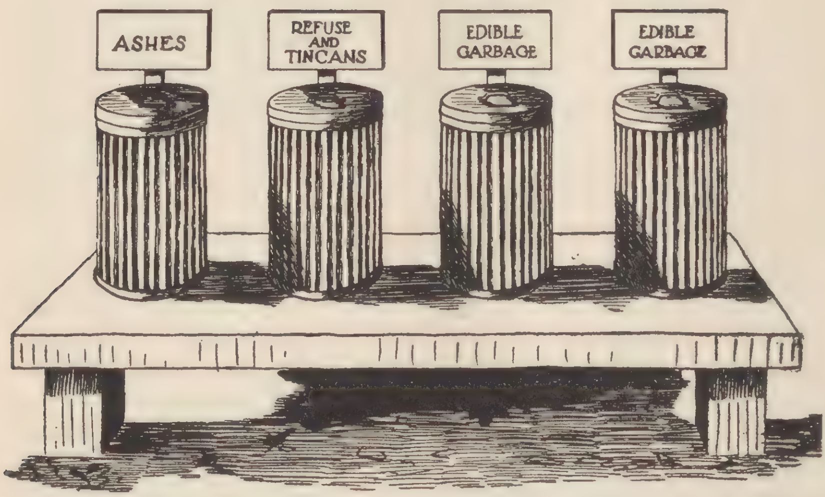

Fig. 36. Garbage cans labeled for collection of classified garbage. (From Dunham's Military Preventive Medicine, 3rd Edition).

Garbage stands. Stands made of concrete or wood (Figs. 36 and 37) should be installed outside of, and adjacent to, kitchens or other buildings in which garbage is produced. The platforms should be raised at least one foot above the ground. If made of boards these should be laid crosswise and separated by at least one inch to prevent the retention of organic matter between them. The stands should not be screened.

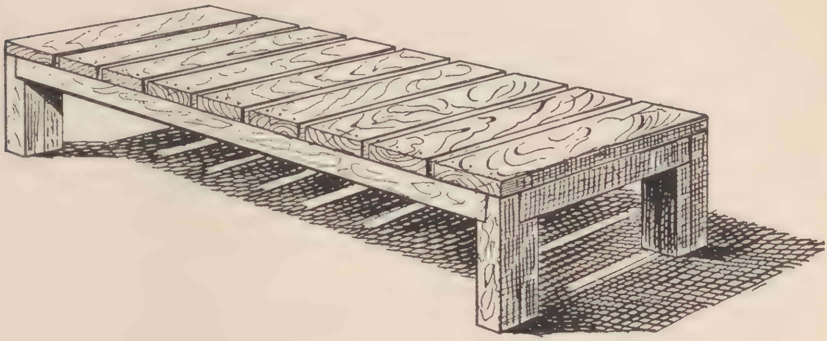

Fig. 37. Garbage stand made of planks. (From Dunham's Military Preventive Medicine. 3rd Edition).

Transportation of garbage. The cans containing the garbage should be transported by truck or wagon to the point of ultimate disposal or to a central transfer point. In order to prevent spillage and consequent pollution of the soil near kitchens, garbage should not be transferred from can to can at kitchens but the cans should be removed to the truck transporting the garbage and replaced immediately by clean ones.

After being emptied, the cans should be cleansed with hot water and lye, hot soapy water, by steam, and by thorough scrubbing on the inside and outside in order to remove all organic matter. If hot water is not available, cold water containing lye or other cleansing compound may be used and the cans scrubbed on the inside and the outside with scrubbing brushes. If the garbage is being fed to hogs, cans which have been cleansed with lye or cleaning compound should be thoroughly rinsed with clear water before being returned to the

kitchens. If the garbage is transferred to a contractor's vehicle, the cans should be cleansed at the transfer station or if there is no transfer station, at the place where the garbage is finally disposed of. Where the garbage is disposed of on the military reservation the cans should be cleaned at the place of disposal. Provision should be made at the place of disposal for straightening dented or battered cans or lids.

The transfer station. When the garbage is disposed of by contract it is usually necessary, particularly in large camps, to install a central transfer station where the garbage is transferred from the cans in which it was collected at the kitchens to the vehicles of the contractor. The transportation of the garbage in the cans to the place of disposal at some point beyond the limits of the military reservation is usually an unsatisfactory method because of the difficulty encountered in cleansing and returning the cans.

Construction of transfer station. The transfer station for a division camp may consist of a platform about 20 feet wide and 100 feet long. At one end of the platform is a storeroom for paper and cans, while at the other end is a room or building in which the cans are washed. A rubbish incinerator is usually installed as a part of the station. The platform should be made of concrete and raised above the ground to about the level of the floor of a truck bed.

Can cleaning equipment. The can cleaning equipment consists of long wooden or concrete tanks containing hot water in which a cleansing compound, such as lye, is dissolved. Small compartments may be provided which are equipped with hot water sprays. The dirty cans are soaked in the long vats after which they are scrubbed with stiff brushes or transferred to the small compartments and subjected to strong sprays of hot water.

Operation of transfer station. Trucks or wagons deliver the full cans at one side of the platform and obtain clean cans for return to the kitchens from the other side. The full cans containing the edible garbage, or that to be disposed of by contract, are emptied into the trucks or wagons of the contractor and the rubbish or useless garbage is sent to the in-

cinerator. The cans are washed in the can cleaning room, repaired if necessary, and replaced on the platform.

The platform and the ground around the station must be kept free from spilled organic matter. The platform should be washed frequently and the waste water drained into a sewer. If necessary, crude oil may be applied to the soil around the platform to prevent fly breeding. A number of well-kept fly traps should be placed in the vicinity of the transfer station.

Care of garbage cans and stands. In order to minimize the danger of spilling the garbage during transportation, the cans should not be filled to within more than four inches of the top. The lids should be kept in place at all times while the cans are at the kitchen, except when they are removed for the purpose of depositing garbage in the cans. Care should be exercised that no garbage is spilled on the ground and if solid garbage is spilled, it should be immediately collected and placed in a can. If the soil becomes soaked with liquid wastes from garbage it will, under suitable climatic conditions, provide a breeding place for house flies.

The platform of the stand should be scrubbed daily with a stiff scrubbing brush and hot soapy water. To prevent fly breeding, the ground around the stand should be sprayed at weekly intervals with crude oil and firmly tamped. Fly traps, well-kept, should be used to trap adult flies on or about the garbage stand.

Preferably, the cans should be removed daily and the intervals between collections should not exceed two days in summer or three days in winter.

Garbage cans should not be whitewashed or painted.

Incineration. Garbage incineration consists of burning the garbage in some kind of a furnace until the combustible portions are completely consumed. Burning garbage produces malodorous gases which, unless they are decomposed by heat during the process of incineration, may create a nuisance. Incineration is the ideal method of garbage disposal in so far as control of house flies is concerned, and if the gases are con-

sumed, also as a means of preventing the production of a nuisance.

Essential features of garbage incineration. The economical and effective disposal of garbage by incineration requires, first, that the incinerator be so constructed that the garbage is pre-heated and partially dried so that it will burn freely; and second, that the gases released by the drying and burning garbage be decomposed before escaping from the incinerator.

In general, in the incinerators that meet these two requirements, the garbage is dried on a drying grate, rack, or hearth on which the wet garbage is placed or dumped. Below or adjacent to the drying grate is a fuel grate on which the dried garbage from the drying grate is burned and from which heat is obtained to dry a fresh charge of garbage on the drying grate. In other and less efficient types, the garbage is placed directly on the fire, the same area or grate serving to dry and burn the garbage.

A minimum temperature of 1250°F., with an average temperatue of at least 1400°F., is required to decompose the obnoxious gases produced by the drying and burning garbage, and a combustion chamber must be installed in which the decomposition of the gases can be effected. In order to dry and burn wet, and sometimes frozen garbage and produce an average temperature of 1400°F., a draft must be provided and, consequently, the gases can be consumed only in a closed incinerator equipped with a suitable stack.

Closed incinerators. The closed incinerator is essentially a furnace equipped with fuel and drying grates and having a combustion chamber and a relatively high stack. The low temperature closed incinerator operates at an average temperature of about 1400°F. The high temperature type develops a minimum temperature of 1800°F. The cost of constructing a low temperature closed incinerator is less than for a high temperature plant, but it is difficult to operate a low temperature plant so that a charge of fresh garbage will not reduce the temperature below 1200°F., and thus permit malodorous gases to escape. On the other hand, the high tem-

perature which is maintained at all times in a high temperature incinerator will effectively decompose all malodorous gases. As one of the primary objectives sought when a closed incinerator is installed is the elimination of nuisances due to odors, the high temperature types are generally more satisfactory at a military station or camp.

The United States Standard Incinerator (Pittsburg - Des Moines Incinerator) is a typical high temperature closed incinerator (Fig. 38). The garbage is dumped on an inclined drying grate through a charging opening in the top of the incinerator, and the dried garbage slides down to the fuel grate to be consumed. The superheated gases pass backward through a throat into a combustion chamber where they are decomposed by heat. The arched roof of the furnace and

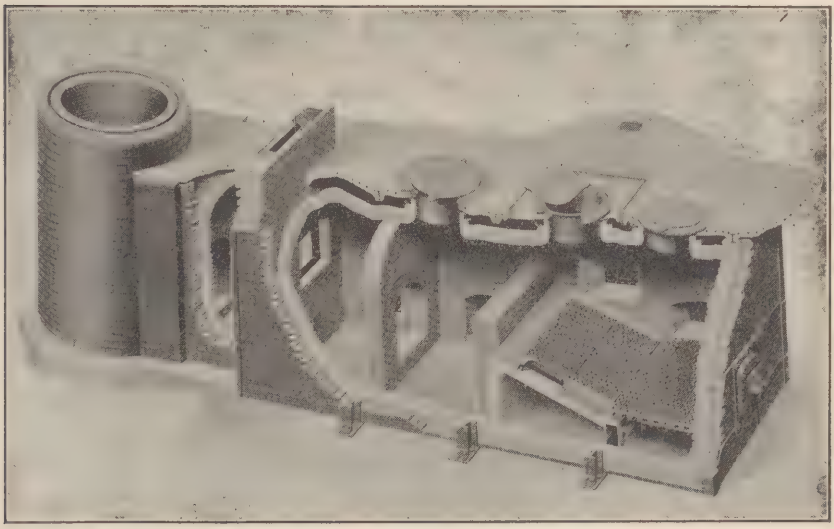

Fig. 38. U. S. Standard Incinerator. This incinerator has a stack about 10 feet high. (Courtesy of Pittsburgh—Des Moines Steel Co. As shown in Dunham's Military Preventive Medicine, 3rd Edition).

a heavy wall fire-proof material prevent lateral expansion and distortion due to the higher temperatures. A stack is provided, which for a 5-ton installation is about 50 feet in height.

The closed incinerator is usually provided with a platform on which the full cans are unloaded and the empty cans removed by the garbage trucks or wagons. Usually, can washing equipment, consisting of a concrete soaking tank and spraying compartment, is provided as a part of the installation.

Other types of closed incinerators differ from the U.S. Standard only in details of construction, the same basic principles being involved Closed incinerators may be employed to dispose of a minimum of from 1 to 20 tons of garbage daily.

The closed incinerator is a Quartermaster Corps installation and is constructed and operated by that branch, as its minimum capacity precludes its use by companies or equivalent organizations.

Advantages and disadvantages of the closed incinerator. A properly constructed and operated closed incinerator will completely destroy all the garbage without producing odors or obnoxious smoke. It requires less fuel under average conditions than the open type incinerator. The absence of nuisance production renders it practicable to operate the closed incinerator near inhabited buildings. The heat produced can be utilized to provide hot water or steam for washing the cans.

The closed incinerator has the disadvantage that it can not be operated economically for the disposal of small amounts of garbage, that is, less than about 1 ton daily and that the cost of construction is comparatively high. The high temperatures, which are essential for the efficient operation of the plant, render frequent repairs necessary and increase the maintenance, depreciation, and operating costs.

The operation of a closed incinerator requires constant, skillful supervision to prevent damage to the incinerator or the creation of a nuisance due to the escape of gases.

A proper understanding of the fundamental principles involved in the disposal of wastes is necessary to all line officers as the duties of the organization commanders, police officers, engineers, quartermasters, and adjutants require an appreciation of the value of these factors in preserving the health of a command and in the avoidance of the production nuisances.

CHAPTER X.

GENERAL CONSIDERATION OF DISEASE.

Definition. The dictionary defines disease as "any departure from, failure in, or perversion of normal physiological action in the material constitution or functional integrity of the living organism". The human body is like a machine composed of many different parts and as long as all of these parts function normally the body runs along smoothly and is said to be healthy. If any part or parts of the body get out of order then a state of "disease" exists.

Causes of Disease. The question is often asked, why do we die? This question can be answered more or less accurately in each separate case of death but it is difficult to answer except in very general terms. Men die (excluding accidents) on account of disease, but some men live much longer than others under similar circumstances. A great many factors enter into the question of the length of the span of life.

The causes of disease may arise within the body itself, these are called *intrinsic* causes, or they may be introduced from without as *extrinsic* causes.

Intrinsic causes. When a machine is run for a long period of time some part or parts are bound to wear out. The same is true of the body and when the worn-out part is one of the vital organs death ensues. As old age approaches, certain degenerative changes occur in all of the vital organs. Usually these changes are more marked in some organs than in others so that the final breakdown is inevitable and certain factors may either hasten or retard this process. There may be a flaw in the machine, a defective organ, the result of heredity which causes a break. On the other hand it is known that certain families are " long lived", so that barring accidents and acute diseases, degenerative processes do not materialize until quite late in life.

There are certain things which tend to hasten degener-

ative changes such as an improper mode of life, especially in regard to exercise and to food. There are also diseases produced by an improper functioning of the glands of internal secretion which may be considered as intrinsic in origin.

Many of these diseases start insidiously and are not detected until either it is too late to do much about it or the condition can be corrected only after long and careful treatment.

The institution of the annual physical examination in the Army was for the purpose of detecting diseases early enough so that corrective measures could be applied. When an officer receives a commission in the Army his service is for a considerable part continued training. He advances step by step through higher grades so that in a few years the Government has invested quite an amount of money in each officer. It is to the best interest of the Government to keep this officer physically fit, and keeping fit is also one of the most valuable assets of the individual in the military service. In civil life there are more and more people each year going to their physicians and requesting this periodic examination.

Extrinsic causes. It can readily be seen that any mechanical injury such as would result from an automobile accident, fall, etc., would be an illness resulting from an extrinsic cause. Likewise the taking into the body of poison or the effect produced by exposure to very high or low temperatures would be so classified. There are many other diseases, however, where the cause arises outside of the body but it is not apparent to the uninitiated that this has happened. Included in this group are all of the communicable or "catching diseases". These diseases are caused by either animal or vegetable organisms which may be introduced into the body in a number of ways. In most cases man himself acts as the greatest source or reservoir for these diseases and the causative organisms are transferred from man to man directly or indirectly. There are some instances where animals act as reservoirs of infection and man acquires disease from them.

Specific causes of disease. For many years diseases have been differentiated by their symptoms, that is by the

way the human body reacted to the disease. It was not until late in the last century that it was proven certain diseases were caused by the introduction into the body of organisms which caused a specific disease. In other words each disease is produced by a definite agent which when introduced into the body causes that disease only. The agents producing most of the communicable diseases are vegetable parasites called bacteria.

Bacteria are microscopic, one-cell organisms which occur as spherical, rod-like or spiral shapes, some of which have the power of locomotion in fluid media. Under favorable circumstances of temperature, humidity and food supply bacteria mature very rapidly and multiply by dividing and redividing. Many species reach this stage in from 20 to 30 minutes so that it is apparent what the progeny of a single cell will amount to in 24 hours. Fortunately, this multiplication cannot go on indefinitely as the local food supply becomes exhausted or moisture and temperature changes may occur which will inhibit growth. The bacteria also produce certain products themselves which tend to restrain multiplication.

Certain bacteria are said to be "spore forming"; that is, at some time during their existence certain changes take place in the cell protoplasm which result in the formation of a resting stage or spore. These spores are much more resistant to destructive agents than the bacteria themselves and may withstand drying for long periods or may still survive boiling for several hours.

Most of the bacteria which cause disease in man grow best at temperatures somewhere near that of the human body, though some grow better at lower, and others at higher temperatures. Bacteria are much more quickly killed by high than low temperatures; for example typhoid fever bacteria are quickly killed at 55°—60°centigrade but may be frozen in ice for months without being killed.

Certain things are necessary for bacteria to cause illness in man. First, there must be a "susceptible" individual, the person who is "liable" to contract the disease should the causative organisms be introduced into his body. Sec-

ond, there must be the specific organism of the disease in such virulence and in such numbers as will cause the disease. It is impossible to say just how many bacteria are required to cause any given disease as the normal body no doubt can take care of quite a few micro-organisms under ordinary circumstances. Finally, these organisms must be brought into contact with those tissues of the body which are susceptible. For example, a person susceptible to typhoid may camp alongside of a stream which is heavily polluted with material containing typhoid bacteria. He will not get typhoid until after he drinks some of this water and introduces the organisms into his gastro-intestinal tract.

When microorganisms are introduced into the susceptible tissues of the body they begin to grow but do not cause any symptoms for some time. This time between the introduction of the organisms and the appearance of symptoms is called the "incubation period". The incubation period is fairly constant for each infectious disease.

As the organisms grow in the tissues they secrete certain poisons which not only act on the surrounding tissue but at times on many other parts of the body.

Immunity is the ability of an individual to resist the action of disease-producing micro-organisms. It is the opposite of susceptibility. The mechanics of immunity are just beginning to be understood although there are still many points which remain unclarified. Briefly the theory is that the cells of the body secrete certain protective substances which either destroy invading organisms or aid other particular body cells to destroy them.

Immunity may be either *natural* or *acquired.* Natural immunity is an inherited or inborn quality of resistance possessed by a race, species or individual. Tuberculosis affects both cattle and man but does not affect dogs. Man does not have fowl cholera and fowls do not have foot and mouth disease which affects cattle and may affect man. Certain individuals have greater natural immunity for certain diseases than others as seen in outbreaks of communicable diseases where a number of people in one family are attacked and some escape although equally exposed.

Acquired immunity is a condition which is brought about either in a natural way by the individuals having had the disease or is caused by the administration of a substance which causes the production of immune substances.

Let us take typhoid fever as an example in its relation to immunity. If a number of persons in a family drink polluted water and a part of them contract typhoid the ones who remain well are said to have a natural immunity. When the ill members recover they will have an acquired natural immunity which will probably protect them against typhoid fever for the rest of their lives. Now, if prior to the drinking of polluted water the entire family had been given typhoid vaccine the immunity produced would be referred to as acquired artificial immunity.

Immunity is a relative condition and is very difficult to measure in most instances. We know from experience, however, that in some diseases we can produce what amounts to absolute immunity. Small-pox is one of these and successful vaccination will prevent the disease absolutely in nearly all individuals. One hundred years ago 20 per cent of all children died of smallpox before they were 10 years of age and even at present it is a disgraceful fact that we have several thousand cases each year which could readily be prevented by vaccination.

Hypersusceptibility is a special state where the individual reacts in an exaggerated way to infection. The term is also used with reference to the reaction of certain individuals to foreign protein. Hay fever produced by certain pollens is an example of this.

There are a number of diseases for which no special micro-organism has been found, but certain of the body fluids from a person sick with the disease may be passed through a fine porcelain filter and when injected into a susceptible person will produce the disease. Whatever causes the disease is ultramicroscopic and to this class of infecting agents has been given the name of viruses.

Definitions of certain terms used in hygiene. There are a number of terms used in hygiene referring to micro-organ-

isms which are harmless as well as those which cause disease. If we were to make bacteriological examinations of water, air, the skin of our bodies, the soil and in fact most of the things with which we come in daily contact we would find many bacteria. When the surgeon performs an operation he *sterilizes* his instruments. By *sterilization* is meant the destruction of all bacterial life on or in the object. The term *asepsis* means the freedon from or absence of living disease-producing germs. *Antisepsis* means the prevention of growth and activity of micro-organisms. An *antiseptic* is an agent which will prevent the action of bacteria without necessarily destroying them.

The Methods of Disease Production. From the standpoint of military hygiene, the methods by which disease of particular importance to an army are produced, may be classified as follows:

1. Those due to pathogenic micro-organisms.
2. Those due to animal parasites.
3. Those due to physical, chemical or mechanical injuries.
4. Those due to new growths.
5. Those due to degenerative changes.
6. A certain group called constitutional diseases.
7. Those due to abnormal function of the glands of internal secretion.

Disease due to pathogenic micro-organisms have been discussed above.

The animal parasites. These include the flukes or sucking worms, the tape worms and the round worms. Flukes are not common in the United States but are prevalent in tropical countries, especially the Philippine Islands. They are of several varieties and may occur in the lungs, brain, liver, blood vessels, bowels, or urinary bladder. They gain access to the body from water bathed or waded in, after first reaching an advanced stage of development in the livers of certain snails, from which they then escape into the water. They pass through the skin of persons using the water. The means of prevention are preventing egg-bearing feces or urine from entering the water or boiling the water before bathing.

The tapeworms are of several varieties, the beef and

pork tapeworms being the most important. The worms require two animal hosts for their complete development, cattle or swine being the intermediate host and man the definitive host. The parasites are obtained through eating infested beef or pork. After entering the intestinal tract of man, they develop from the head of the ingested worm into a great number of segments joined together in the form of a long, flat ribbon. Each segment discharges eggs which, if ingested by the intermediate hosts, cattle and swine, begin the life cycle of the tapeworm anew. Their prevention lies in careful meat inspection, thorough cooking of the meat, disposal of human excreta in such a manner that it is not accessible to cattle and swine and debarring the use of human excrement as fertilizer.

Round worms require no intermediate host and infection passes from man to man. The eggs are laid in feces and pass from the anus, whence they may get on the hands into drinking water, or on green vegetables, and so obtain entrance to the mouth and stomach of another person.

Hookworm disease (uncinariasis) is the most important worm disease of man. In Puerto Rico, the Philippines, and the southern part of the United States the disease is common. It causes marked debilitation. The worms enter the body by penetrating the skin of the individual's bare feet, pass to the lymph and blood channels, and finally lodge in the small intestine. Hookworm disease has been successfully combatted in Puerto Rico through the efforts of the late Army surgeon, Colonel Bailey K. Ashford.

Diseases due to physical, chemical or mechanical injuries. Marked disability may result from exposure to sudden changes in temperature or excessive heat or cold. Heat and cold predispose to disease by lowering the body resistance. Heat stroke or heat prostration is rather frequent in places where the air is heavily saturated with moisture, the temperature excessive, and the movement of the air deficient. The effects of heat stroke vary from mild headache to delirium and even death. Prolonged exposure to cold results in a lowering of body temperature until it reaches about 20°C., when death occurs. Short exposure to extreme cold

may result in frozen extremities which may become gangrenous. Light, X-ray, and electricty may be destructive to body cells. Increase or decrease of atmospheric pressure may result in disease or even death. The effect of exposure to adverse pressures may be seen in divers, caisson-workers, and aviators.

Chemical injuries derange the activities of the body cell temporarily or permanently. These injuries are usually due to poisons such as lead, arsenic, bichloride of mercury, and iodine. Plant and animal poisons are also common. Most poisons taken into the digestive tract are absorbed into the blood and produce a general effect. Gaseous poisons may be absorbed by the lungs, carbon monoxide being a common example. Phosgene and mustard gas, much depended upon in gas warfare,are lung irritants. Liquid chemical poisons such as strong acids, sulphuric or nitric, and strong alkalies such as caustic potash, caustic soda, or lye, are common causes of injury, particularly in the industries. Vegetable poisons include opium, strychnine, and cocaine. Alcohol in excess is poisonous.

Mechanical injuries are of considerable importance to a military force. They include such conditions, due to traumatism, as fractures, wounds of all kinds, head injuries, rupture of internal organs, and other lesser results of external violence. Hemorrhage and shock are often complications of violent mechanical injury.

From growths. The term "new growth" refers to benign tumors and *cancers*. These are spoken of as new growths because the body tissues in which they appear have departed from their normal method of growth and have taken on a form of growth new to the body. The benign tumors may be removed surgically and the disease cured. The cure of cancer is often extremely difficult or impossible. The treatment is essentially surgical and must be applied early in order to be successful. Cancer is more frequent after the fortieth year of life.

Degenerative changes. The degenerative changes in the body, of course, begin at birth but their deleterious affects become more serious after the age of forty. They are manifest-

ed particularly by increasing difficulty for the heart, blood vessels, and kidneys to carry on their normal functioning. These structures may become impaired to such an extent as to result in partial or complete physical disability. Deaths resulting from these degenerative changes are relatively much more frequent than formerly was the case. The same is true of deaths from cancer.

Constitutional diseases. There is a certain group of diseases considered as constitutional diseases, the most important of which are diabetes, gout, and obesity. These diseases result in disability sufficient to incapacitate one for military service, although, if properly treated they are compatible with long life. Careful attention to diet may be of considerable benefit in their prevention.

Endocrine diseases. There are certain diseases due to abnormal function of the glands of internal secretion whose exact cause is unknown. Disease of the thyroid gland resulting in goiter is a common occurrence. Fortunately, most cases, if properly treated, can be cured.

Heredity. What part heredity has to do with producing disease is not definitely known. Certainly a predisposition to certain diseases may be inherited and it is equally true that rarely is it possible to demonstrate that a particular disease was passed from the parent to the off-spring. Syphilis may be congenital. Haemophilia, a congenital condition characterized by delayed clotting of the blood and consequent difficulty in checking, shows an inherited tendency, descending only through females to manifest itself in males.

CHAPTER XI

COMMUNICABLE DISEASES.

Nature. Communicable diseases are those which are transferred from one person to another. The terms "contagious" and "infectious" disease are sometimes used but these lack scientific precision. In some instances of communicable disease the relationship between one case and another may be far removed in time and space but it exists nevertheless. The term "preventable disease" is a pertinent designation as it signifies that the disease has occurred as a result of errors in conduct of our hygienic and sanitary administration. However, "preventable" is a broader term than "communicable" as some preventable diseases are not communicable.

Communicable diseases may be classified according to their mode of transmission and character of control measures considered applicable at the present time. Such a classification is as follows:

1. Respiratory diseases transmitted by discharges from the mouth, nose, throat, and lungs.
2. Intestinal diseases transmitted by dscharges from the intestinal and urinary tracts.
3. Insect-borne diseases transmitted by blood sucking insects.
4. Venereal.
5. Miscellaneous. These include certain preventable diseases which do not readily fall into the above classes. The ones of most importance to the military service are tetanus, anthrax, epidermophytosis, food deficiency diseases such as scurvy, beri-beri and pellagra; infectious jaundice, tularemia, scabies, gas gangrene, and plant dematitis.

Characteristics. As a group the communicable diseases have many features in common. These characteristics are as follows:

They are caused by viruses, bacteria, or *protozoan parasites.* In many instances the exact cause is unknown, particularly in certain respiratory diseases. In most of these diseases of unknown cause viruses are generally believed to be the causative agents. Bacteria cause by far the greatest number of communicable diseases. The methods of transmission of most diseases are well understood and proper control procedures can be applied.

They pass easily from person to person. This transmission may be through personal contact or through contaminated objects with which susceptible persons come in contact. There are varying degrees of communicability among these diseases. Measles is highly communicable and there is practically a universal susceptibility to this disease. Pulmonary tuberculosis, on the other hand, is only mildly communicable, and under satisfactory living conditions the healthy adult posesses sufficient immunity to resist the usual sources of outside infection.

They occur more commonly during infancy, childhood, and adolesence. About half of the nearly three million cases of communicable diseases reported each year in this country occur in children.

During mobilization or periods of concentrated training, with a large number of young recruits, we would expect a relatively high rate of communicable diseases. The order of frequency probably would be common respiratory diseases, measles, mumps and venereal diseases. Any one of them (with the exception of venereal disease) might become epidemic and change the frequency, as did influenza during the World war. Measles and mumps are extremely difficult to control since outbreaks are of an explosive nature. Venereal diseases can be controlled by chemical prophylaxis.

They have an acute onset and a more or less rapid termination. In many instances the early symptoms and signs are of such short duration and so mild in character that little opportunity is offered to remove the case from contact with well persons. The course of the disease in most instances is short, and recovery is complete.

A well-marked seasonal variation in occurrence is observable. In general, the more common communicable diseases may be classified according to their seasonal periodicity into three main groups. First, a summer group, including the intestinal and insect-borne diseases. Second, a winter group of respiratory diseases, which spread mainly by personal contact and droplet infection. Third, an autumnal group of a less definite character, including such throat infections as diphtheria, scarlet fever, and septic sore throat. The above seasonal classification is not applicable in the tropics, where the rainy and dry seasons are the chief influences.

The respiratory diseases differ in seasonal periodicity from the intestinal diseases. These diseases are spread by droplet infection. The infectious virus is incapable of prolonged existence outside the body. Some of the most "infectious" of these diseases are those in which the droplet infection results from sneezing and coughing, which may be provoked either by the disease itself or by an intercurrent catarrah. The co-existence of a "cold" or any other condition causing coughing or sneezing will make the case or carrier of respiratory disease more infectious. Droplet-borne infections are intimately related to overcrowding. During the cold season there is a marked increase in intimacy of contact between persons, particularly in squad and day rooms.

The relationship between atmospheric temperature and respiratory diseases is rather marked, especially in cases of pneumonia and bronchitis, and less so in measles and whooping cough. Common respiratory diseases such as colds and acute nasopharyngitis are most prevalent during the months from November to April. Cold strongly predisposes to respiratory diseases. It does not precipitate the disease or control it once it has assumed epidemic form.

One attack of a communicable disease may confer either a temporary or a lasting immunity. Rarely does one suffer a second attack of typhoid fever, smallpox, diphtheria or scarlet fever. However, second or repeated attacks of malaria or pneumonia are not infrequent. The degree of immunity acquired against the common respiratory infections is

quite variable. No lasting immunity is attainable against such diseases as common colds; however, a relatively high degree of resistance is attainable under certain conditions. It is well known that seasoned soldiers show fewer common respiratory infections than recruits. Through contact over a considerable period of time the seasoned soldiers become relatively immune to the various disease-producing micro-organisms constantly present in the upper respiratory passages of their associates. On the other hand, recruits are unaccustomed to close contact and are very susceptible to invasion by the various disease-producing organisms harbored in the nose and throat. The higher incidence of measles and mumps among recruits from rural, as compared with those from urban, districts is explained by the greater degree of contact and exposure to these diseases in cities and the consequent large number of immunized individuals in urban populations.

Communicable diseases occur many times in epidemic form. By the term epidemic is meant a disease that is common to many people; a disease outbreak that spreads among the people, affecting a large number at one time but only for a limited period. In some localities a particular disease may occur at any time because of certain local conditions. Such a disease becoming wide spread, involving adjacent communities or large areas of different states or nations, is termed a pandemic. Influenza was pandemic in 1918 and 1919. Many of the communicable diseases are capable of becoming epidemic, especially during the training or mobilization of large numbers of men. Respiratory diseases, particularly, are liable to become epidemic under such conditions and are the most difficult to control. Intestinal, insect-borne and venereal diseases are essentially controllable but will assume epidemic form if vigilance is relaxed in the administration of sanitary precautions.

There is a great probability that all communicable diseases are preventable. There is no group of diseases which strikes real terror more quickly or more thoroughly than do communicable diseases, because they come almost without warning and may rapidly incapacitate a large proportion of a

command. Every effort must be made to prevent any disease from becoming epidemic. However, until the exact cause is determined and methods perfected to combat the particular causative agent, control of those diseases of unknown origin must depend upon the application of general control measures. Those diseases for which we have a specific means of prevention have shown an enormous reduction in incidence since the application of preventive measures.

Isolation is a term used to denote that the patient is removed from all contact with persons other than his immediate attendants and that every precaution is being taken to insure that infectious materials leaving his body are so treated as to render them harmless to others. Isolation may be used in the handling of patients, carriers, and suspects. It is a very strict medical procedure requiring all attendants of the patient to have a thorough understanding of just what is to be done.

Quarantine is the separation of the contacts of a case of communicable disease from the non-contacts. It may be applied to one or a number of persons. While in quarantine all usual activities may be carried on except those which will necessitate mingling with non-contacts. A daily inspection of persons quarantined is made by a medical officer for the purpose of detecting early cases of the disease. This constitutes the group or working quarantine which is used throughout the Army in the control of respiratory diseases. A quarantine continues for a prescribed time depending upon the incubation period of the disease.

The transmitting agency is the means whereby the material capable of causing disease is conveyed to a well person.

Methods of Production. The causative agent. The primary factor in the production of communicable diseases is the causative agent. In many instances the agent is known and can be effectively combatted. In some instances the exact cause is unknown. In all instances the fundamental requirement for the causative agent to produce disease is that it find a suitable place to grow and multiply. This site or reservoir is usually man and his body discharges. There are a few non-

human reservoirs of disease. In tularemia the human infection is mainly contracted from handling the flesh of infected rabbits and ground squirrels. Bubonic plague is a disease the infectious agent of which lurks in a non-human reservoir, rats and other small rodents.

The patient is the most obvious source of infection but not the only one and not always the most important. The person that is definitely ill and under satisfactory isolation and treatment has no opportunity to disseminate the infectious agent. An individual, however, may be so slightly ill that he does not seek medical advice. This type is called a sub-infection or missed case and may readily spread the disease. Occasionally the symptoms may be confused with those of some other disease and the correct condition not determined, then cases are termed atypical and the patient, unless isolated, will spread the infectious agent. The relative degree of infectiousness of a person suffering from a mild form of the disease as compared to a well marked case is not definitely measurable. In epidemic disease of the central nervous system, such as infantile paralysis, it is believed that the severe case is no more infections than the mild case or carrier.

A carrier is a person who, although not ill, is giving off from his body germs capable of causing disease in others. Such persons are important sources of certain diseases particularly diphtheria, typhoid fever, meningococcic meningitis, infantile paralysis, and septic sore throat.

Environment. The secondary factor in the production of communicable diseases from the standpoint of the military service is the environmental conditions peculiar to the service. The grouping together of large numbers of men in camp or garrison increases contact and invariably increases the difficulties in housing, ventilation and messing. These conditions are ideal for the production and spread of communicable diseases, especially respiratory or droplet-borne infections. In addition, the supplying of a potable water, disposal of human wastes, and fly control may become major problems which greatly influence the production and spread of intestinal diseases. All of these conditions increase the importance of

providing and enforcing proper hygienic and sanitary regulations. On the march, in the field, during concentrated training, the temporary occupancy of home or foreign territory, or the mobilization of the civilian population, these problems may reach gigantic proportions.

An unusual factor from the standpoint of the production of communicable diseases, but a most important factor in the military service, is the commanding officer. The commanding officer of each organization is responsible for the health and sanitation of his organization and the area occupied by it. Certain procedures for the protection and promotion of the health of the troops, such as immunization against typhoid fever, small pox, tetanus and yellow fever and the physical examination of all applicants for enlistment, are universal throughout the military service and are directed by the War Department. The Medical Department functions in an advisory capacity. However, Medical Department officers possess the technical knowledge and training in health work. The Department is charged with the responsibility of making the investigations and recommendations for the actual initiation of health measures by higher military authority. Proper co-operation between commanding officers and Medical Department officers is fundamental to the health of any military command.

Thus, the methods of production of communicable diseases in the military service are concerned with three factors. First, the causative or infectious agent which finds a favorable place to live and multiply in the case or carrier. Second, the environmental conditions peculiar to the military service. Third, the responsibility of the commanding officer of each organization acting upon the advice of Medical Department officers.

Spread of Communicable Diseases. The spread of communicable diseases depends upon certain fundamental conditions. The community or given population must contain susceptible individuals who will be exposed to the disease. There must be a source (patient or carrier) of such a nature that the causative micro-organisms will reach the transmitting agent. Transmitting agencies must be available to convey the viruses

or micro-organisms from the source to the susceptible person. In certain instances, particularly in intestinal diseases, the source need not be in the immediate locality. In typhoid fever, for example, the reservoir of the causative agent is the human body; the micro-organisms leave the body in the feces, the urine, and in discharges from the mouth, nose and throat, and may be conveyed by water, milk or flies for a considerable distance.

Diseases spread from person to person in three ways—by contact, through food, including water, and through insects. Contact is of two kinds—direct and indirect. During direct contact the sick and well persons are so close together that the infectious material passes immediately from the one to the other. In indirect contact the infectious material passes from the sick to the well person almost immediately through some intervening object or substance used by both.

Fig. 39. Factors in the control of communicable diseases.

The respiratory diseases are spread primarily by contact, and secondarily, through food. Intestinal diseases are spread usually through food and water, and occasionally by contact. Insect-borne diseases are spread only by blood-sucking insects. Venereal diseases are spread almost entirely by direct contact during sexual intercourse.

In addition to contact, the transmitting agencies concerned in communicable diseases are food, water, and insects. Food and water are concerned chiefly with the transmission of intestinal diseases. Insects act as transmitters of intestinal diseases by being mechanical carriers of contaminated food or feces. It may pithily be said that feces, fingers, flies, and

food are the agents by which many of our communicable diseases are spread, particularly the intestinal diseases.

Epidemics. An epidemic of a communicable disease results when the conditions enumerated above are particularly favorable. Thus, there must be in a given population a considerable number of people who, if exposed to the disease, are very likely to become ill. This is termed group susceptibility. If only a few people are susceptible to the particular disease, the probabilities of that disease being transmitted to new human hosts are decreased and for this reason the disease fails to assume epidemic proportions. The source from which the disease may be transmitted, either a case or a carrier, must also be present. However, the number of cases or carriers, in the early phase of the epidemic, need not be large, if the group susceptibility is high and the transmitting agencies are readily available. An epidemic will occur in a community only when conditions are favorable for the dissemination of the causative agents. For example, water-borne disease prevails only in the presence of a contaminated water supply; respiratory disease prevails where crowding exists; and insect-borne diseases are transmitted from person to person only when the insect host of the causative organisms is present.

The knowledge of the effects of epidemics upon armies has been gained through bitter experience. Until comparatively recent years epidemics had taken the major toll of the losses. During the nineteenth century general sanitary conditions were greatly improved, but not until the specific causes for many of the communicable diseases were discovered did adequate control procedures become available. The efficacy of specific control measures is strikingly illustrated by the following statistics. During the Spanish-American War one out of every five men in the American forces contracted typhoid fever. During the World War vaccination against typhoid fever was compulsory, and less than one out of every thousand vaccinated contracted this disease.

Control of Communicable Disease. Three factors are essential to the spread of communicable diseases; namely, a source, susceptible individuals, and a means of transmitting

the infective agent. The control of the spread of these diseases can be accomplished by efforts directed at any one or more of these three basic factors (See Fig. 39).

Control of the source. The early detection of cases of a communicable disease is of primary importance. In the Army "sick call" is often the time that the first case of a transmissible disease is discovered. Following the detection of the first case and any additional cases the ill persons must be placed in isolation. Isolation serves to separate the source of infection from the transmitting agents.

Quarantine, should be applied to those who had close contact with the patient. Such persons are those sleeping in adjacent beds or occupying adjacent seats at the mess table. If several cases have occurred simultaneously or within a short time the entire organization should be inspected once, and preferably twice, daily by medical officers to detect early cases.

During the mobilization of a large number of recruits detention camps should be established. The recruits are detained in such camps for sufficient time to permit the development of diseases to which they may have been exposed. This will largely prevent the introduction of communicable disease into a non-infected command. Even when recruits are received singly or in small numbers they are potential sources of infection and should be inspected daily by a medical officer during the first two weeks for evidence of a communicable disease. The essential feature, then, in the control of the source of the disease is the control of the patient or carrier by early detection, prompt isolation, quarantine of contacts, and close observation of recruits.

Control of transmitting agencies. Contact is prevented through measures directed at controlling the source of infection. The control of food is secured by obtaining good food, its preservation and the prevention of its contamination before it is eaten. Milk must be obtained from healthy cows, pasteurized, and properly protected prior to and after delivery to the consumer. Water is of the greatest importance to all troops, and unless it is potable it may be a dangerous transmitting agency. Water and food in relation to disease are fully

discussed in Chapters VII and VIII. Insects as transmitting agents are largely controllable. Methods for accomplishing this are discussed in Chapter XIV.

The fundamental purpose of all disease control procedures in the Army is that of preventing a disease from becoming so prevalent and widespread that it will interfere with the mission of the military command. It may be highly desirable to effect a quarantine of a large command during an epidemic of meningococcic meningitis, but the mission of the military force might make it unwise to remove such a large number of men from active participation at that time. It must also be borne in mind that the principle of control of communicable diseases is based on benefits to the group or command as a whole. Most adults are relatively immune to the childhood disease; however, outbreaks of measles, mumps, scarlet fever and other diseases are of frequent accurrence, and are of considerable importance to a military force, as they make the non-effective rates. The control of measles is more important to the Army than is the control of some of the more severe diseases, such as pulmonary tuberculosis. To the individual the latter offers far greater concern, but the number incapacitated from pulmonary tuberculosis is relatively small as compared to yearly non-effectives from measles. Also the non-effective rate resulting from measles in the presence of an epidemic might materially interfere with the military mission, while a few cases of pulmonary tuberculosis would have relatively little effect.

It is imperative that all military commands maintain the highest degree of health. Susceptibility to disease varies inversely with the general condition of the body and may change from day to day. Excessive fatigue, undue exposure to heat or cold, and lack of proper nourishment will increase susceptibility. Thus, efforts directed toward the developing and maintaining of the highest degree of general health must be a constant objective of all military commands.

CHAPTER XII

RESPIRATORY DISEASES

The respiratory disease group occupies first place as a cause of admission to sick report in the Army. These are the most universally prevalent of the communicable diseases. They are endemic everywhere, epidemics are frequent, and pandemics sweep the world like a devastating plague about once a generation. In general, they are caused by viruses and pathogenic bacteria. Their infectious agents are contained in the discharges of the mouth, nose, throat, and lungs. They spread by direct contact with case or carrier and by indirect contact through the media of air, hands, food, and mess equipment. They are less understood and more difficult to control than are intestinal, insect-borne, and venereal diseases. Diseases which spread from person to person are much more difficult to control than those transferred by inanimate intermediaries.

Classification. Respiratory diseases may be classified in two groups, depending upon their relative communicability. First, those which are highly communicable, have a marked tendency to occur in explosive outbreaks, and incapacitate at one time a large proportion of a command. Their exact causes are not known and the application of efficient control procedures is difficult. The principal diseases of this group are:

1. Measles.
2. Mumps.
3. Influenza.
4. Common Respiratory Diseases.
    a. Common colds.
    b. Acute tonsillitis.
    c. Acute naso-pharyngitis.
    d. Acute pharyngitis.

e. Acute laryngitis.

f. Acute bronchitis.

In the second group are included those diseases whose causes, with the exception of smallpox, are known. As a group they infrequently occur as explosive outbreaks, are more easily controlled, and their spread through a command is often so retarded that they do not greatly interfere with the military mission. In smallpox and diphtheria specific preventive measures are applicable. The principal diseases in this group are:

1. Diphtheria.
2. Meningococcic meningitis (cerebro-spinal fever).
3. Scarlet fever.
4. Pneumonia.
5. Smallpox.
6. Septic sore throat.
7. Vincent's angina.

Septic sore throat and, to a lesser extent, diphtheria, may be spread through milk and milk products, but since the infectious micro-organisms are present in the discharges from the nose and throat they are classified as respiratory diseases. Septic sore throat often occurs in explosive outbreaks due to infected udders of cows and continues until the infected animals are eliminated as a source of milk supply.

Methods of Transmission. Respiratory diseases are transmitted from person to person by direct contact with the infectious source, patient or carrier, and by indirect contact through the media of certain transmitting agencies, such as air, hands, food, and mess equipment. Cases of respiratory diseases are generally most infectious before definite symptoms develop. The tendency of people to remain indoors, often under crowded conditions, particularly during the winter months, furnishes the greatest opportunity for contact with cases and carriers and is accountable for the increased prevalence of these diseases at this season. Carriers are important transmitters of diphtheria and meningococcic meningitis and, to a lesser extent, of pneumonia, common respiratory diseases, and probably scarlet fever. Carriers are not a factor

in the transmission of measles, mumps, influenza, smallpox, septic sore throat, pulmonary tuberculosis, and Vincent's angina.

The transmission of respiratory diseases by indirect contact through air-borne channels is important. This does not mean that the air about us normally contains sufficient pathogenic bacteria to cause disease nor that the expired air of a normal person is contaminated. The theory of aerial transmission of disease was developed before the exact nature of infection was determined. Consequently the spectre of infected air has been a difficult one to dispel. It has been definitely shown that what really occurs in air-borne infection is that living bacteria are carried by the air for short distances in tiny floating particles of liquid expelled from the mouth, nose, throat, or lungs, during loud talking, singing, sneezing, and coughing. This method of transfer of disease is more correctly termed droplet infection.

Droplets of infectious materials sneezed or coughed out are larger and heavier than droplets of saliva; they may fall to the floor or lodge on the hands, dishes, food, eating utensils, toilet articles, or numerous other objects. These droplets are easily visible and the distance to which they may be carried or sprayed varies considerably, depending upon the force with which they are expelled and the velocity and direction of the air currents. The droplets may float in the air for several minutes, and have been known to remain afloat as long as six hours. During quiet breathing bacteria are seldom recovered even as near as six inches from the mouth of the infected person; after coughing, however, they may be recovered from all parts of a room. As a working basis, a distance of less than five feet between the faces of individuals will permit the spraying of others with droplets of infectious material from the respiratory tract. This is the fundamental rule upon which, in the military service, the principal control procedures relative to respiratory diseases are based. The number of pathogenic organisms in the air of a sick room varies inversely with the adequacy of the ventilation, other things being equal.

The hands serve as important transmitting agencies of the respiratory diseases. The fingers become contaminated with

nasal and oral secretions, and distribute the latter to everything that the hand touches, be it food, eating utensils, handrail, or book.

The ordinary pocket handkerchief contaminates the fingers many times each day. This little ornament of the well dressed man or woman is the reservoir of massive droplets of infectious materials. Its uses are innumerable. It is the storeroom for discharges from the mouth, nose, throat, and lungs; it serves as a dust cloth for the chair or park bench and absorbs the moisture from a perspiring brow. The same instrument is then often used as a drying or cleansing cloth for the hands, dishes, or eating utensils. It would not be amiss to state that few people would consider using the handkerchief as a store place for secretions from an organ infected with a venereal disease. Yet these organisms live for a shorter period of time outside the body than do many of the bacteria and viruses of the respiratory diseases stored in the pocket handkerchief.

Food, after being contaminated from the droplets expelled through coughing or sneezing, serves as a transmitting agency of respiratory diseases. Also the soiled hands of the cook, kitchen police, and mess attendants contaminate all food that they touch. It is of great importance to prevent persons with, or carriers of, these diseases from working in kitchens, mess halls, post exchanges, restaurants, or other places in which they handle food. The symptoms of common cold may be the forerunner of other diseases, especially measles or influenza. Practically, then, the affected person should be relieved from duty and not permitted to return until fully recovered and found not to be a carrier.

The mess equipment is closely related to food as a transmitting agency of respiratory diseases. It is subjected to contamination by mess personnel; in addition each soldier may contaminate his own and his comrades' mess gear by coughing or sneezing. All dishes should be carefully sterilized after using and all utensils used in the mess should be thoroughly cleansed with soap and water before using. Fig. 40 shows factors in the control of respiratory diseases.

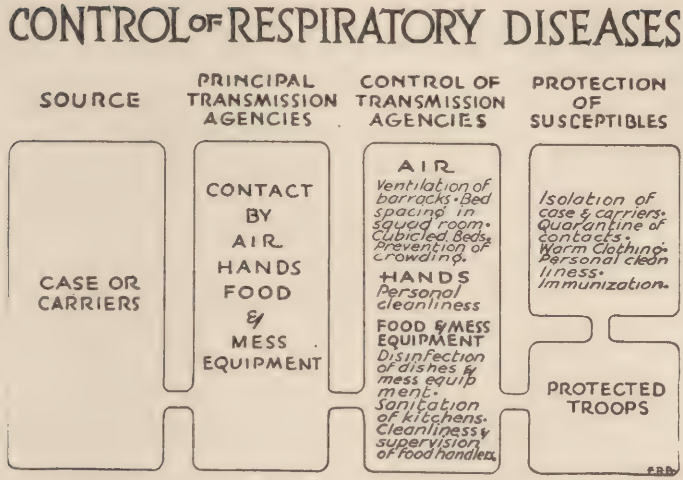

Fig. 40.

Control. The control of respiratory diseases involves measures affecting the source, the transmitting agencies, and the protection of susceptibles. Unfortunately, this group contains diseases which give rise to only mild symptoms so "missed" cases are frequent, this being particularly important in the dissemination of these diseases. The transmitting agencies are more difficult to control than are water or insects. Too, the group susceptibility is high and, except for smallpox, we have no specific preventive measures applicable to large military forces. Therefore, we must direct our efforts along the line of general control precedures that have proved of value.

Control of the source. To control the source of respiratory diseases, prompt isolation of each case in the hospital is essential. Persons presenting symptoms suggestive of these diseases, that is, suspects, should be isolated in a hospital and receive close medical observation. Group quarantine of contacts is of no practical value in highly communicable diseases which occur in explosive outbreaks, as in influenza, but it is of great value in retarding the progress of epidemics of diseases classified in the second group. Known carriers should be hospitalized. However, it is generally not

feasible in large commands to attempt the detection of carriers. More important in controlling the source is the alleviation of overcrowding during mobilization and the establishment of detention camps in which to detain recruits for a sufficient time to permit the development of symptoms of any communicable disease to which they may have been exposed.

Control of transmitting agencies. Control of the transmitting agencies of these diseases offers greater opportunities for retarding their spread than does control of their sources or the protection of susceptibles. In several instances the exact cause of these diseases is unknown. Therefore, we cannot attack the causative agent as such by a specific means. We must, then, attempt to control the agencies through which the disease is known to be transmitted. The general principles upon which we control these transmitting agencies are: a. Proper ventilation, b. proper bed spacing, c. prevention of overcrowding, d. barracks sanitation, e. proper mess sanitation, and f. special measures for recruits.

Proper ventilation of barracks and quarters. Ventilation is the adjustment of atmospheric conditions so as to promote health, comfort, and efficiency. Poor ventilation with the resultant increase in humidity or atmospheric temperature, or both, favors the spread of respiratory disease by interfering with the heat regulating mechanism of the body, thereby decreasing the resistance of the tissues of the respiratory tract to infection. Poor ventilation of barracks or quarters causes the occupants to exchange micro-organisms by rebreathing their expired air, the germ content of which has been increased by coughing and sneezing.

The ill effects of poor ventilation alone are due to heat, moisture, and stagnation of the air surrounding the body. By stagnation of the air is meant a deficiency of air movement. The effect is the same as the increasing discomfort experienced when an individual is exposed to high atmospheric heat. The air in sleeping quarters should have a movement easily felt on the back of the hand and a flow through the room amounting to 1800 cubic feet per hour per occupant. A properly ventilated room will not feel stuffy or hot when entered.

The proper ventilation of an occupied barracks or quarters requires that the air be moved through the room, that is, admitted and removed in such volume and with such velocity that the atmospheric temperature and relative velocity will remain approximately constant within certain limits and without the production of uncomfortable drafts. For practical purposes, the existing air conditions of a barracks or quarters may be determined by the temperature as shown on the thermometer and by the effect of air movement on one's senses. Overheating as shown by the thermometer means poor ventilation regardless of its cause. With a satisfactory thermometer reading a sense of discomfort due to excessive warmth or stuffiness of the air is indicative of high relative humidity, insufficient air movement, or both, and again means poor ventilation. Thus, there must be a proper balance between these three factors, heat, moisture and air movement, to effect good ventilation.

Methods of ventilation, There are two methods of ventilation, natural and mechanical. Natural ventilation depends upon an interchange of indoor and outdoor air through openings in the walls. In barracks or quarters it is usually easy to control the volume of air required, but the control of its velocity and the prevention of drafts may be difficult. It may also be difficult to secure an equal distribution throughout the room. Natural ventilation is easily and adequately obtained by opening windows at the bottom on the windward side and at the top on the other side (Fig. 41). The area of these openings depends upon the number of occupants, the velocity and direction of the wind, the difference in temperature between the indoor and outdoor air, and the construction of the building. As a working basis 1.5 square feet of inlet and outlet surface is required for every ten men in sleeping quarters when the outside temperature is about 50°F. If the windows are on one side only or if the inlet and outlet are at the same level, the air will be short circuited with an uneven distribution in the room. Drafts are prevented by having several small inlets rather than a few large ones. Also, the use of de-

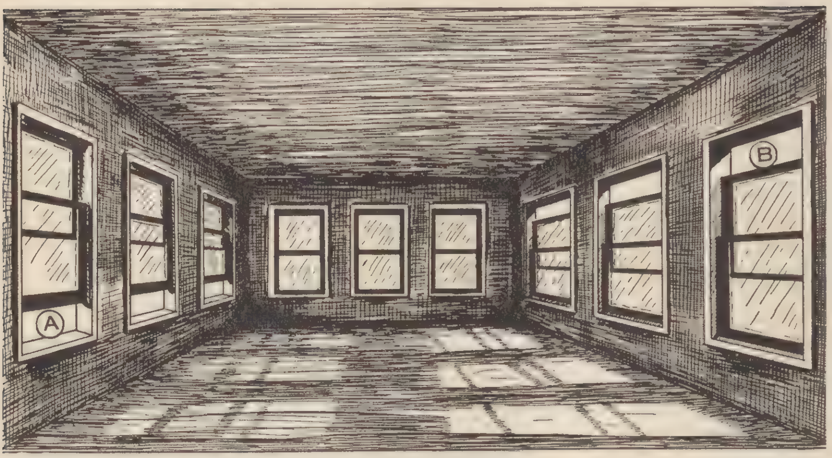

Fig. 41. Natural ventilation with open windows. (From Dunham's Military Preventive Medicine, 3rd Edition).

flectors in the window openings (Fig. 42) aids in decreasing drafts.

If troops are housed under canvas, the sides of the tent should be rolled up daily and the hoods opened if weather conditions permit. In temporary buildings provided with single sash sliding windows, provision should be made for such numbers of window openings for the entrance of air as the weather conditions permit. In rooms which have been ceiled, there should be openings in the ceiling to permit the escape of air to ridge ventilators.

The ventilation of barracks, tents, and other places in which troops are housed is the responsibility of the organization commander and is obtained only by careful and constant attention on the part of commissioned officers. Non-commissioned officers must be instructed in the essentials of and necessity for obtaining good ventilation. Non-commissioned officers in charge of quarters must check the window ventilation several times each night, especially during the respiratory disease season, November to April.

Proper bed spacing. In barracks, each soldier should have a floor space of 60 square feet with 720 cubic feet of air volume.

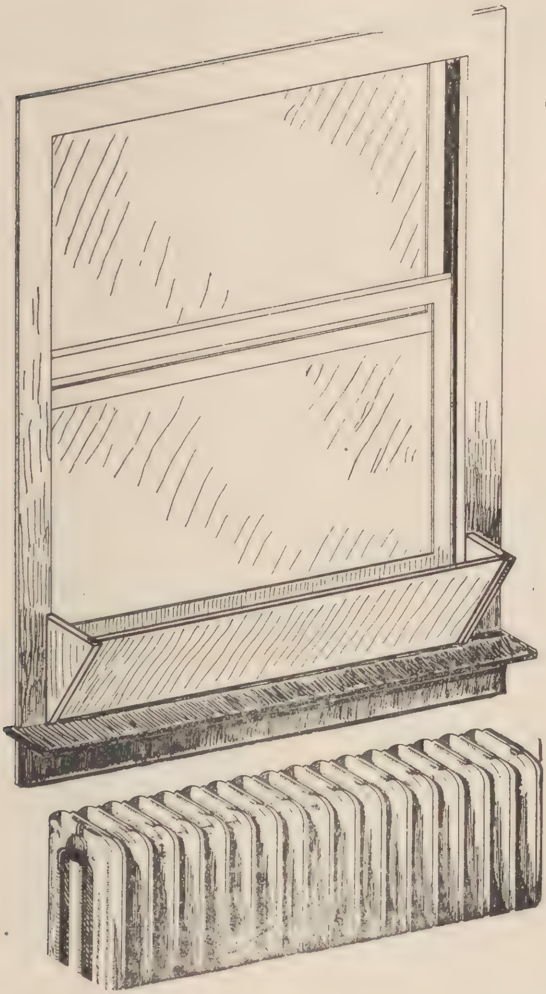

Fig. 42. Relation of window board ventilators and radiator. (From Dunham's Military Preventive Medicine, 3rd 5dition).

Beds must be so placed that under average conditions the deep breathing of sleeping occupants will not spray secretions from the nose and throat into the air to be inhaled by those in nearby beds. With an allowance of 60 square feet per man there exists six feet distance between the heads of the men. This distance is

adequate to prevent the usual contamination through droplet infection. Bunks should be so arranged that there is head to foot sleeping and the beds made up that way for morning inspections. (See Fig. 43). When necessary, staggering of beds will aid in securing the desired distance between men.

All squad rooms should have the authorized capacity, based on the allowance of 60 square feet per man, posted on the entrance door. Regardless of the size of the room, 24 occupants should be the maximum. Not exceeding this number is important for with an increased number of men the probabilities of having a carrier of respiratory diseases present is increased. Also, the number of contacts that occur

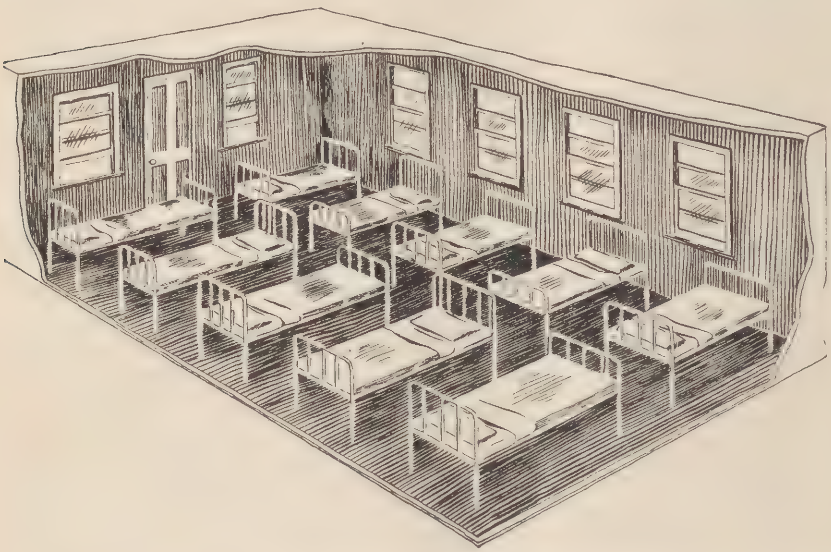

Fig. 43. Method of arranging beds in squad room showing head and foot arrangement. (From Dunham's Military Preventive Medicine, 3rd Edition).

is increased should a case of a respiratory disease develop. Tentage should supplement inadequate barrack space, assigning six men to a pyramidal tent, provided the troops will not be subjected to adverse weather conditions. Wide spacing of beds will not compensate for poor ventilation. If beds are

too close together the air has to move at such a velocity that undesirable drafts are produced. Decreasing of bed space should not be permitted as it increases contacts should cases or carriers of disease be present. More beds mean more men exposed to respiratory disease with a resultant higher non-effective rate and probably epidemics.

Cubicles. Whenever conditions will not permit six feet between the heads of the men, the beds in the squad rooms should be separated by screens to convert each bed space into a cubicle. The cubicle screen is readily made from an ordinary shelter tent half (Fig. 44), blanket, sheet, or boards. The screen made from a shelter half may be fixed on a bed

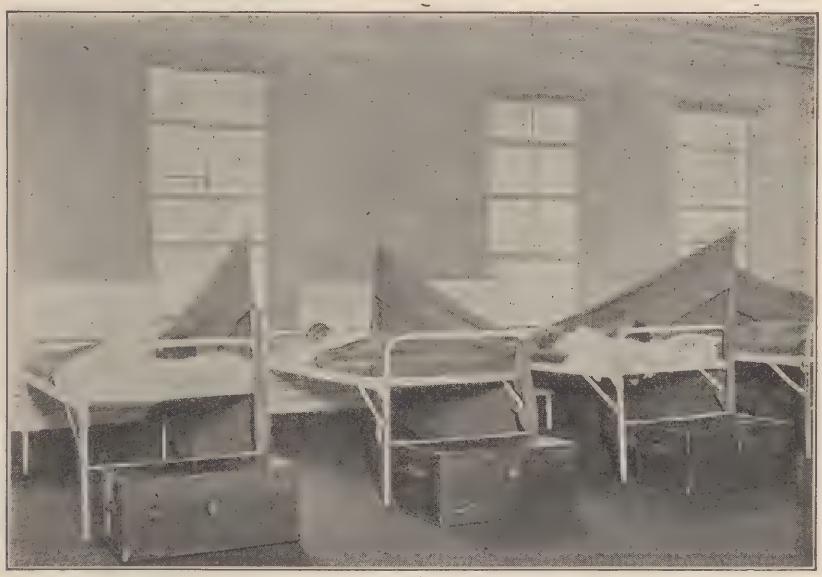

Fig. 44. Method of constructing cubicles in squad room by the use of shelter tent halves with head and foot arrangement of beds. (From Dunham's Military Preventive Medicine, 3rd Edition).

or cot by tent poles. The screen extends 2-4 feet above the surface of the head of the bed, the height decreasing toward the foot, and extends about one foot below the cot or bed. If the screen is too short, too low, or does not extend below the bed, air currents may carry the infectious secretions of an oc-

cupant over the upper edge, around the lower end, or under the edge of the screen to adjacent occupants. If cubicles are too high or extend too far beneath the bed, they interfere with the movement of the air and cause improper ventilation. Head to foot sleeping is essential. Cubicles are used for all recruits during the respiratory season (November to April) and for all troops in the presence of or during a threatened epidemic.

Prevention of overcrowding. The rate of spread and the extent of an epidemic of any respiratory disease is largely dependent upon the closeness of contact between infected and non-immune persons. The control of crowding or close contacts is, therefore, the most important factor in the control of respiratory diseases. This is accomplished only by constant supervision by the commissioned personnel. It is aided by proper ventilation, proper bed spacing, occupying alternate seats at the mess hall and theater, minimizing close order drill, and limiting gatherings in the squad or day room by providing diversified entertainment. The closing of theaters and the discontinuance of military training cause idleness among the troops. Under such conditions they naturally congregate in service clubs, day or squad rooms, post exchanges, and offices, which nullifies the objective for which the theaters were closed. Further, idle troops have poor morale, and the discipline necessary to enforce proper control procedures is more difficult to maintain. Notwithstanding these facts, it may at times be necessary to close theaters and discontinue most military activities.

Barracks sanitation. Proper barracks sanitation means cleanliness and, like ventilation, is a responsibility of organization commanders. There are certain sanitary precautions, however, that are essential to cleanliness. Spitting on the floors, dry sweeping of the floors, careless coughing, sneezing, and expectoration, and the use of common drinking cups and towels must be prevented. An ample supply of cuspidors, containing a 2 per cent solution of cresol to a depth of one to two inches, is important. Cuspidors must be cleaned daily. Bedding should be aired twice weekly. Beds must be thoroughly cleaned with soap and water at frequent intervals.

Proper mess sanitation. There are several essential features

of mess sanitation applicable to the control of respiratory diseases. First, sick persons or carriers employed in mess halls contact either directly or indirectly through contaminated food and utensils practically the entire command and should immediately be relieved from such duty. Second, dishes and mess equipment should be properly cleansed and sterilized under the supervision of a non-commissioned officer. Third, cleanliness of the mess hall, kitchen, refrigerators and food containers is an important part of mess sanitation. Fourth, the cleanliness of mess personnel, their hands, fingernails, and clothing is fundamental in the serving of wholesome food.

Recruits. All incoming recruits should be kept apart from other troops until time for the development of respiratory diseases has elapsed. If this is not possible, and the number of recruits is small, daily inspection by medical officers to detect the early signs of respiratory diseases is essential. Recruit training need not be interfered with during this time.

Principal Respiratory Diseases. The respiratory diseases of the most importance to the Army are those that cause the greatest number of days lost from duty. They are those diseases of the first group, that is, measles, mumps, influenza, and the common respiratory diseases. Their characteristic tendency to occur as explosive outbreaks and the difficulties encountered in their control account for their importance to a military force and warrant further consideration.

Measles. Measles is a disease peculiar to man. Its exact cause is unknown but is believed to be a virus. There is universal susceptibility, and one attack confers a permanent immunity. Increasing age does not decrease susceptibility and the only reason many adults are immune is because they have had the disease. Measles occurs in epidemic form. There is a fairly regular periodicity of epidemics at two year intervals in this country.

Prevalence and importance. Measles occurs most frequently in childhood and in densely populated communities. Few escape the disease during their early years. While it is most dangerous in infancy, it is of importance to an army because of its complications.

There is a great difference in the susceptibility of urban

and rural populations to measles. Recruits from urban and rural populations show a great difference in susceptibility to measles. This is because the city boy has had a much greater opportunity to have measles in his childhood.

Transmission. The mode of transmission of measles is by direct contact. Only the smallest amount of virus is necessary and the shortest exposure is sufficient to provoke the disease. The virus is contained in the secretions of the nose and throat and is conveyed to susceptible persons by coughing and sneezing. The droplets of the infectious material may fall on objects and be transferred immediately to the hands and mouths of susceptible persons with the resultant production of the disease. A characteristic of the disease is a running nose and irritation of the eyes which begin several days before the eruption, at which time the disease is communicable and continues to be so for five days after the disappearance of the rash.

Control. The control of measles in the Army is based upon measures which tend to retard its spread, thus decreasing the number of men incapacitated at any one time. These measures are:

1. Isolation of patients, particular efforts being directed toward detection and isolation during the stage of prodromal or early symptoms.

2. Group quarantine of contacts with daily and preferably twice daily inspection by medical officers for the purpose of detecting early cases of the disease.

3. Adequate ventilation of barracks and proper spacing of beds.

4. Application of such general measures as moderate exercise in open air, exposure to sunlight, and avoidance of fatigue and chilling.

5. The establishment of detention camps when large numbers of recruits are being received.

Mumps. It is believed that mumps is caused by a virus, but this is not definitely known. The infectious virus is contained in the saliva and to a lesser extent in the discharges from the nose. Man is universally susceptible and one attact usually confers a lasting immunity.

Prevalence and importance. Mumps is most prevalent in children between the ages of seven and nine years. However, the susceptibility among young adults is greater than it is to measles. Troops from rural districts are, as in the case of measles, more susceptible than those from urban communities. There were 230,356 cases of mumps among American troops during the World War. It had the third highest non-effective rate, being exceeded only by influenza and venereal diseases. It is seldom fatal.

Transmission. Mumps is transmitted by direct contact or by contact with articles freshly soiled by the secretions or discharges from the mouth or nose of an infected person. It is contagious before definite symptoms appear and continues so until all swelling of the salivary glands has disappeared.

Control. The control of mumps is based mainly upon the procedures outlined under the control of measles, the most important factor being the early detection and prompt isolation of cases. The incubation period of mumps is relatively long and epidemics tend to develop slowly. Secondary cases frequently develop outside of the personnel in contact with the first case. For that reason, group quarantine is of little value.

Influenza. Influenza is an acute, highly communicable disease caused by a virus and characterized by wide-spread epidemics. There are in fact three diseases, which it is impossible to differentiate clinically, which go under the name influenza (influenza A, B and Y each caused by a distinct virus). There is a universal susceptibility and the recovery from one type of influenza does not protect against the others. No definitely proven method is as yet available by which artificial immunity may be conferred.

Prevalence and importance. When influenza sweeps over the world in pandemic form, it becomes the most serious and furious of epidemics on account of the large numbers attacked in a short time. During the pandemic of 1918-1919, it is estimated that there were 200,000,000 cases and 10,000,000 deaths in less than 12 months. In the United States there were approximately 20,000,000 cases and 450,000 deaths in six months.

Pneumonia is a frequent complication of influenza. In 734,

397 cases of influenza which occurred among the enlisted men of the Army during the world war, both in the United States and in Europe, there were 24,205 concurrent cases of pneumonia. Influenza apparently has a much higher incidence among newly recruited troops than among those having relatively long service. This may be due to a non-specific immunity acquired through prolonged contact. Probably more important is the fact that trained troops are better disciplined, and control measures are more efficiently executed.

Transmission. So far as known, influenza is transmitted by direct contact through transfer of respiratory tract secretions from infected persons to the respiratory tract of susceptible individuals. The incubation period is short, 24 to 72 hours, and communicability is high during the early stages of the disease. The duration of communicability is not known. Carriers may exist but probably are of little importance. The rapidity of spread of influenza is remarkable. The first authentic case of virulent influenza in Army camps in the United States appeared at Camp Devens, Mass., Sept. 7, 1918, and by September 20th the peak of the epidemic at that camp was reached. The fact that a high percentage of those ill with the disease in its early stages do not go to bed or are not isolated accounts to a considerable degree for the rapidity of its spread.

Control. The explosive nature of epidemics of influenza and the rapidity of spread make effective control very difficult. The most important measure in the control of an epidemic is the prevention of crowding since this decreases the contact between individuals. The maximum bed space available must be allotted, the use of cubicles made mandatory, only alternate rows and alternate seats should be occupied at theaters and messes, and all gatherings in squad rooms or elsewhere prohibited. Group quarantine is of no practical value. Medical examination of the entire command once and preferably twice daily is most necessary. Strictest attention must be given to the health of the mess personnel, and any one complaining or presenting symptoms of illness must be relieved immediately.

Common respiratory diseases. Acute inflammations of the nose, throat, and larger bronchi are included in this group. About one-third of the admissions to sick report for diseases are due to common respiratory diseases. The common cold is typical of the group and is the most prevalent disease known to man. The cause of the common cold is unknown. A variety of organisms have been held responsible and there are doubtless many capable under certain conditions of causing colds.

Transmission. The common respiratory diseases are spread from person to person by contact through droplet infection or by hand to mouth conveyance of the infectious agents through contaminated objects. Carriers may be of importance, although this is not definitely known.

Control. The control of common respiratory diseases lies in avoiding contact with the case and guarding against the predisposing causes. The education of the public in personal and public hygiene is of greatest importance in the control of these diseases. Good ventilation, proper bed spacing, sufficient clothing, personal cleanliness, avoidance of promiscuous spitting or kissing, and caution as to the common use of such articles as the drinking cup, are factors in decreasing the prevalence of these diseases.

Diphtheria and meningococcic meningitis are essentially carrier diseases. Their control, however, depends not so much on extensive efforts to detect carriers in a large military force as upon detection of early cases, their prompt isolation, and quarantine of the contacts.

Septic sore throat, essentially a milk-borne disease, is eradicated only when the infected animal is eliminated as a source of milk supply or the infected milk handler is isolated.

Smallpox is prevented by vaccination.

Vincent's angina is controlled and prevented by proper oral hygiene.

Pulmonary tuberculosis among adults affects chiefly persons who overwork or do not pay proper attention to their general health.

CHAPTER XIII

INTESTINAL DISEASES

Nature. Intestinal diseases are those whose causative agents are discharged from the body in the feces and urine. They are transmitted, with the exception of hookworm disease, from person to person through indirect contact by infected food and water and occasionally by direct contact. The infectious agent must enter the alimentary tract in sufficient numbers in order to cause its particular disease. The causes and modes of transmission of intestinal diseases are well understood in theory and their prevention is attainable in practice. For a few diseases, typhoid fever, for example, specific preventive measures are applicable. In most instances prevention is attained through proper sanitary and hygienic precautions. In some instances one attack confers a lasting immunity, in others repeated attacks may occur. These diseases as a group are more prevalent during the summer months and bear a close relation to the season during which flies are most abundant. The control of this group of diseases is the Army's most noteworthy achievement in the field of preventive medicine. The principal intestinal diseases are:

1. Typhoid and paratyphoid fevers.
2. Cholera.
3. Dysentery.
    a. Bacillary.
    b. Amoebic.
4. Common diarrhoea.
5. Infestation by worms.
6. Food infection.
7. Food intoxication.

Methods of Transmission. The intestinal diseases are transmitted principally in food, including water, and occasionally by contact.

Water-borne. Untreated water is probably the chief conveyor of intestinal diseases. Typhoid and paratyphoid fevers, cholera, dysentery, and diarrhoea are transmitted by water. The original source is, of course, the patient or carrier. The causal organisms are eliminated from the body in the feces and urine and enter the water. The entrance into the water may be through the disposal of sewage directly into bodies of water or from the drainage of privies or fecal deposits into water sources. The micro-organisms causing these diseases generally do not multiply or remain alive for prolonged periods in the water. However, the typhoid bacillus is very resistant to cold and may remain virulent in ice.

Outbreaks of water-borne intestinal disease may be of two kinds. First, outbreaks of an explosive nature. An inspection of the water supply may reveal that feces of typhoid patients have entered the water shortly before the outbreak. Such outbreaks are most apt to occur in the spring when the heavy rains wash the fecal material into the streams. This type of outbreak is usually of short duration. Second, outbreaks may be more or less continuous. When considerable amounts of raw sewage are discharged into streams, the water may be continuously charged with the causative micro-organisms. The users of untreated water under such circumstances suffer from a continuously high death rate of intestinal diseases.

The introduction of modern methods of sewage disposal and treatment together with the present methods of purification of water have rendered water in most cities and towns free from typhoid bacilli. These desirable conditions have not been universally established in small towns and practically not at all in rural districts. These are extremely important considerations from a military viewpoint as the water supply in the field will be obtained chiefly from nearby streams. These streams may contain surface water which is subjected to gross contamination by drainage from numerous privies on nearby farms and in small towns. The only safe procedure to follow in the field is to consider all surface water, including that of shallow wells, as contaminated. All such water must be sterilized before being used.

The importance of fecal contamination of the soil is a very important consideration to the health of armies, especially as regards the intestinal diseases such as typhoid fever, diarrhoea, and dysentery. The Typhoid Commission of 1898, composed of Major Walter Reed, Doctors Vaughn and Shakespeare, has presented a picture of conditions as they existed in the Spanish-American War. This report should be carefully studied by every Army officer. Quoting from Dr. Vaughn's book,—"Camp pollution could scarcely have reached a higher degree of universal prevalence than was the case in Chickamauga Park. Latrines were frequently overflowed by heavy rains and their contents distributed on the adjoining surface. Fecal matter was deposited not only in the latrines but behind every tree and bush. One could not walk from one regimental organization to another without soiling the feet with fecal matter. The whole of Chickamauga Park was strewn with human manure." The intake water pipe for Chickamauga Park was located near the junction of Chickamauga Creek and Cave Spring Branch, streams which drained much of the polluted soil. In addition, water was obtained from wells and springs in the park. This water received drainage from the camp and was grossly contaminated. It is not surprising that 20 per cent of the command became ill with typhoid fever.

Water-borne intestinal diseases may result from bathing or swimming in grossly polluted waters, from the use of polluted water in brushing the teeth, and from the use of raw foods which have been washed in polluted water. The purification and protection of drinking water used on boats and trains must be carefully supervised to prevent it serving as a transmitting agency.

Milk-borne diseases. Milk is an excellent culture medium for all of the bacteria which produce intestinal diseases. It becomes contaminated usually not within the body of the cow but after or during its removal from the udder; commonly because the milker or some other person who handles the milk is a carrier; frequently because the water used in the milk handling process is impure. It is possible that occasionally the udder and other parts of the cow's body become

contaminated when the animal wades in polluted water or lies upon ground bearing human excreta. When milking is done without due regard to cleanliness, as is the case so frequently, material from the surface of the udder or other parts of the cow's body may drop into the milk.

Milk is an excellent and generally used food. It is an important agency for the transmission of intestinal diseases as well as certain others of which septic sore throat and scarlet fever may be mentioned as examples. It must not be considered as a safe food unless every step in its handling has been carried on in compliance with the most rigid sanitary requirements. It is the opinion of sanitarians at present that fresh milk should be pasteurized prior to its use as human food. In the process of pasteurization milk is subjected for a definite period of time, usually thirty minutes, to a temperature of 145°F. This is sufficient to destroy those pathogenic bacteria which are likely to be present. Subsequent to pasteurization the milk should be cooled at once to a temperature of 50°F. and maintained at that temperature at least until it reaches the ultimate consumer. It is further recommended that the milk be dispensed in bottles rather than in bulk in order that contamination subsequent to pasteurization may be avoided. The modern dairy plant is a highly mechanized establishment in which, when operated satisfactorily, a perfectly safe milk can be produced. There are, however, many instances in which unsatisfactory operation has given rise to serious outbreaks of disease. It is highly desirable that the milk reaching a dairy plant should have been originally produced under the best possible conditions.

Fly-borne diseases. The house fly is of extreme importance in the transmission of intestinal diseases. Human excreta is one of the substances in which the insect often breeds and upon which it feeds. It is also strongly attracted to the food of man. While it is feeding, the fly regurgitates and defecates freely. Pathogenic organisms in human excreta are carried to food on the feet, mouth parts, and body of the fly and also deposited through the regurgitated and defecated material. Much of the typhoid fever, dysentery, and common

diarrhea occurring during the summer and early autumn is transmitted by the fly.

Food. Pollution of the soil in which vegetables and fruits are raised and of the water in which shellfish are grown may give rise to disease-producing contamination. In many parts of the world and particularly in the Orient human excrement is used as fertilizer. Most of the waters in this country from which oysters and crabs are taken have, in the past, been grossly polluted. Milk products, salads, custards, hashes, and sandwich fillings may become contaminated during their preparation if the food handlers are ill or are carriers of disease-producing organisms. Beef and pork may be infested with tapeworm; pork is commonly infested with trichina. Rats, mice, and roaches may convey infectious material to foods from latrines and sewers. Foods should be rigidly protected during production, transportation, and preparation.

Carriers. Typhoid and paratyphoid fevers, amoebic and bacillary dysentery, and cholera are transmissible by human carriers. By this is meant those individuals who are eliminating the causative organisms although they themselves are apparently well. Probably in most intestinal diseases the important carriers are those who have had the disease several years previously.

The danger from this source can be fully presented by reciting an actual incident. The history of "Typhoid Mary" a cook, is classical in American medicine. In 1906 an outbreak of typhoid fever occurred in a family residing at Oyster Bay. All possible sources of the disease were thoroughly investigated, and at last it was found that a cook was responsible. This cook, Mary Mallon, had been employed by the family three weeks prior to the onset of the first case in the house hold, had remained about three weeks thereafter and then disappeared. She was found after a time and, although she refused to give any information concerning her past life, it was discovered through other sources that during the preceding ten years she had worked as a cook in eight families and that typhoid fever had occurred in seven of them. She was placed in a detention hospital by the health authorities. Bacteriologi-

cal examination of her stools revealed that typhoid bacilli in large numbers were present constantly. "The cook was virtually a living culture tube in which the germs of typhoid multiplied and from which they escape in movements from her bowels. When at toilet her hands became soiled, perhaps unconsciously and invisibly so. When she prepared a meal, the germs were washed and rubbed from her fingers into the food. No housekeeper ever gave me to understand that Mary was a particularly clean cook." (Quoted by Vaughn from Soper).

The further history of this woman is interesting. She was kept in detention for three years. In 1910, on her promise not to take employment as a cook or engage in an occupation which would bring her into contact with food, she was discharged. Her whereabouts were not known for nearly five years. In January and February 1915, an outbreak of typhoid occurred in the Sloane Hospital for Women in New York City. An investigation showed that Mary Mallon, alias "Typhoid Mary" was employed there as a cook. She was arrested in 1922 and again placed in a detention hospital. She is known to have caused ten outbreaks and fifty-one cases of typhoid. The number of unknown cases due to her are probably many more than the above figures indicate.

The percentage of carriers of intestinal diseases to be found in a large military force cannot be stated. It has been estimated after very careful study that the percentage of carriers of typhoid bacilli in the population of the United States is between 0.2 and 0.3.

Contact. Under ordinary peacetime conditions direct contact is a relatively infrequent method of transmitting intestinal diseases. The cases properly isolated are unable to disseminate the infectious agents. In war, however, this may be an important mode of transmission. Vaughn reports that the Typhoid Commission of 1898 found that men would be detailed from combat troops to the hospitals to care for typhoid patients during the day and return at night to their own organization. These men were ignorant of the nature of infection and methods of disinfection, and no adequate instruction was given them. As a result, they contaminated not only the

food with which they came in contact but all manner of objects in the tents of their associates. Blankets and tentage became soiled with typhoid discharges and were one of the methods by which the disease was spread. Personal cleanliness could have eliminated this means of transmission. By contact as a transmitting agent of intestinal disease we refer to the transfer of the infectious agents to another individual directly or through a close intermediary.

Control. The control of intestinal diseases among military forces can be accomplished. Their control depends fundamentally upon their prevention and the following general measures essential to attain that objective:

1. Purification and protection of water supplies.
2. Proper inspection and protection of food supplies
3. Proper disposal of waste materials.
4. Fly control.
5. Immunization.
6. Sanitation of messes.

All water sources in the field, such as streams, lakes, springs, and ponds must be considered as contaminated and the water treated by chlorination before being used. The procedure as outlined on the cover of the water sterilizing bag (Lyster bag) must be followed carefully in chlorinating the water. The potable water must at all times be protected from flies, dirt, and other outside contamination. Faucets on the Lyster bag must not be used as drinking fountains, and drinking cups must not be dipped into the bag. The use of any water other than that which has been properly treated must be prevented. This subject is fully discussed in Chapter VII.

The inspection, preservation and protection of food supplies is of great importance in preventing intestinal disease. This subject is fully discussed in Chapter VIII.

Waste disposal is of great importance in the spread of intestinal diseases. The human waste materials contain the infectious agents of practically all the intestinal diseases. Proper disposal of these wastes is of paramount importance. In the field strict attention must be given to the construction, location and care of latrines. These subjects are covered in Chapter IX.

The fly development and characteristics A brief description of the development of the house fly and of some of its chief characteristics is essential to the understanding of the control procedures recommended. In its development the fly passes through four stages—the egg, the larva, the pupa, and the adult (Fig. 45). The eggs are oval, white, glistening bodies about 1/20-inch in length. They are deposited in warm, moist, organic material by the adult female in

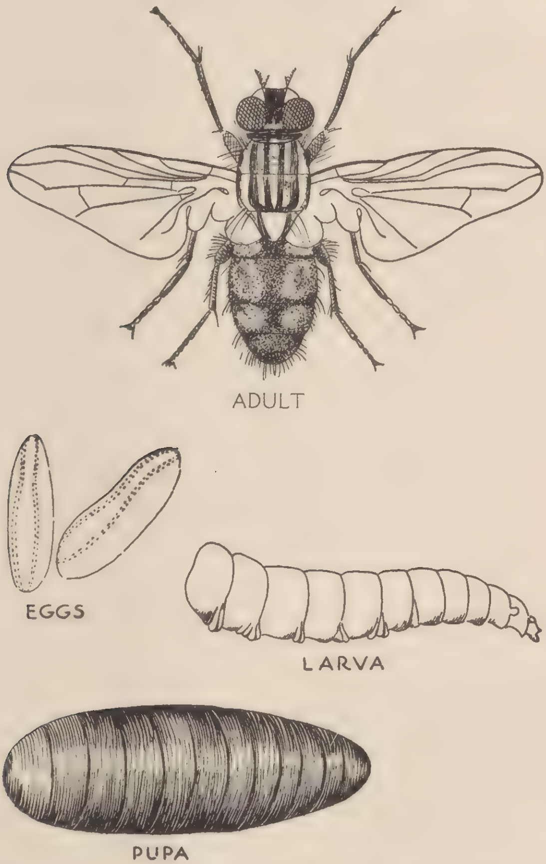

Fig. 45. Stages in the development of the fly.

masses of 150-200. The egg stage lasts about 12 hours, varying considerably with the temperature. The larvae (maggots) are cylindrical, grayish, segmented, worm-like creatures about 1/3-inch in length. They are very motile, feed upon the surrounding organic material, and reach maturity in 2 to 8 days.. When mature the larvae migrate to a dry cool place and pupate. The larvae are quickly killed by a temperature of 115°F. The pupa is dark brown in color, has a hardened outer surface, and is about 1/4-inch in length; it has no mouth parts, cannot feed and is not easily destroyed in this stage. This pupal stage lasts 2 to 8 days. The adult fly emerges from the pupal case and is ready to fly as soon as its wings harden. The female reaches sexual maturity and begins to deposit eggs in 3 to 20 days after emerging from the pupal case. Under favorable conditions, the period from the egg to adult may be as short as one week; thus material in which the immature forms develop may produce flies if neglected for periods longer than one week.

The characteristics of the fly important in its control include:

1. Their breeding places of choice, which are horse manure, human excreta, and fermenting vegetable wastes.
2. The necessity of moisture, warmth, and soluble food for the development of the larvae.
3. The fact that temperature of 115°F. or above will kill the larvae.
4. The tendency of the larvae to migrate from the breeding material prior to pupation.
5. The ability of the larvae and adult to crawl through loose manure or earth.
6. The attraction of adult flies to food by odor.
7. Their tendency to go toward light.
8. Their tendency to rest on vertical surfaces and hanging objects.
9. The optimum temperature for breeding is 80-95°F.
10. The range of flight is 200-1000 yards.

11. The number is greatest in the late summer and early fall.
12. Continuous breeding may occur during the winter, particularly in heated buildings.

Control. The control of flies is based upon a knowledge of the characteristics enumerated above and comprises the measures necessary to render the customary breeding places unfavorable for breeding, the destruction of the larvae by use of larvicides, the trapping of adult flies, the disposal of human excreta in such a manner that it will be inaccessible to flies, and the protection of food from flies.

The control of fly breeding is often the problem of the proper disposal of horse manure. The amount of manure accumulated averages ten pounds per animal per day on picket lines, twenty-five pounds in stables. Flies deposit their eggs in manure very shortly after it leaves the animal's body, that is, while the material is still warm, moist, and odorous. It is almost certain that eggs are not deposited in manure that is more than two or three days old. If the manure is dried promptly, the eggs in it may not hatch, and should they do so the lack of moisture interferes with development of the larvae. Therefore, in camps of short duration manure may be scattered thinly and dried by the heat of the sun; it may be burned after slight drying or by the aid of additional fuel. Burning is an unsatisfactory method of disposal because of the intensely disagreeable odor produced. Manure should not be placed in loose piles since this favors the retention of moisture, thus permitting the continuation of fly breeding. Disposal by scattering would be especially undesirable if the camp site were to be used by other troops in the near future.

In semi-permanent camps and permanent stations manure is frequently disposed of by contract, that is, it is given or sold to non-military personnel who use it for agricultural purposes. Manure is an excellent fertilizer and may be used to great advantage on any military reservation. Its value as a fertilizer is increased by composting, a process in which the material is decomposed to such an extent that the chemicals contained are much more easily available for plant use. The decomposition

is a chemical process and is accompanied by the production of heat. In properly composted manure, a temperature is produced which will quickly kill the fly egg and larva. By the use of larvicides the fly larvae on the surface can be destroyed. Figs. 46 and 47 illustrate the proper construction of a compost platform and the method of placing the manure.

Immunization. Certain intestinal diseases may be further controlled by active immunization. This is especially true of typhoid and paratyphoid fevers and to a lesser extent of cholera and bacillary dysentery.

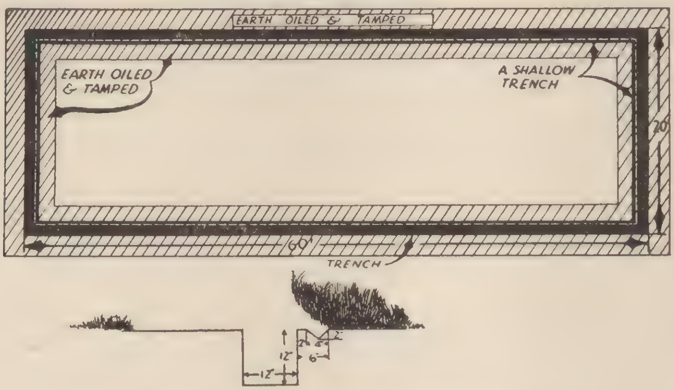

Fig. 46. Plan of a compost platform.

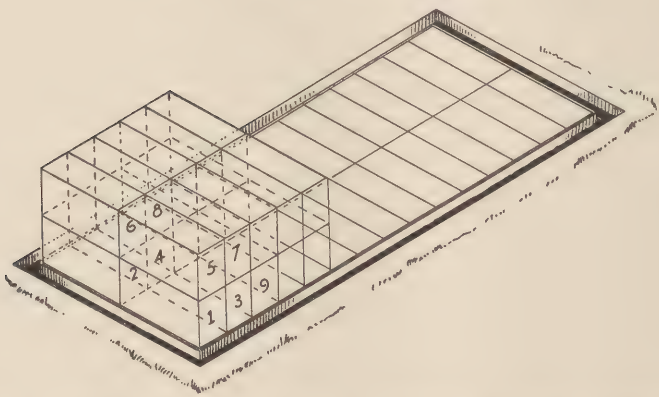

Fig. 47. Method of piling manure on compost platform (schematic).

Active immunization against typhoid fever is required by Army Regulations. The immunity produced is not absolute but will in most instances afford protection against other than quite heavy doses of infection for as long as three years.

Cholera vaccine is of value in protecting troops exposed to this disease and provides protection for about six months.

The dysentery vaccines provide protection but for a short time and their administration is not considered a practicable military procedure.

Mess Sanitation. The underlying principle of mess sanitation is cleanliness. In temporary camps field ranges or rolling kitchens are provided; in semi-permanent camps screened temporary buildings with ranges, ice boxes and mess tables may be present. In either case, good sanitation is very essential in order to prevent the spread of disease, particularly that of the intestinal and respiratory diseases.

The importance of the proper inspection and storage of foods is considered in Chapter VIII. The proper disposal of kitchen wastes is discussed in Chapter IX. In addition to these, there are certain other requirements for the proper sanitation of a mess.

Dishwashing in temporary and semi-permanent camps. In temporary camps mess gear is washed in galvanized iron cans containing water heated by gasoline burners or by being placed over a fire trench. The trench, 8 feet long, 12 inches wide and 12 inches deep, is dug in the vicinity of the kitchen. A fire is built in the trench and the water in the cans heated to boiling sufficiently early to permit a minimum of fire and smoke to be present when the men are washing their mess equipment. The water, however, must be boiling when it is being used. Three cans should be provided, two containing boiling soapy water, the other boiling clear water (Fig. 48). The food particles are scraped into a can or pit in the ground, then each man washes his mess equipment by passing it through the two soapy waters then through the clear water. Sufficient time must be allowed each man to clean thoroughly and air dry his mess kit. The water from the cans must be removed and the cans thoroughly cleansed after each meal. The food particles are buried or

Fig. 48. Washing mess kits using three G. I. cans. (From Dunham's Military Preventive Medicine, 3rd Edition).

disposed of in an incinerator.

In semi-permanent camps a somewhat different apparatus for washing mess kits may be used. (Fig. 49). It consists essentially of a fire trench with a stack at one end. It is built over a soakage pit. The pit is 11 feet long, 4 feet deep and 2 feet wide and is filled to within one foot of the surface with vary-

Fig. 49. Washing mess kits using apparatus made from oil drums

ing-size stone. Along the two sides and one end a wall of stone, brick or concrete is built extending 2 feet above the ground level, forming a fire box. The water containers are made from 50-gallon oil drums cut along the longitudinal axis, 4 inches above the center line. Drums with bungs should be used and so cut that the bunghole will be at the lower most part of the drum when placed on the fire box. Pieces of iron pipe of sufficient length are threaded at one end to fit the bungholes and drilled at the other end to receive an iron rod used to turn them in or out. After the drums are placed on the fire box the space between the drums and walls, between the ends of the drums and between the rear drum and the stack should be filled with clay. This device will require a relatively small amount of fuel to boil the water and the draft will be such that it will be found desirable to place a damper in the stack. The men can wash their mess equipment without being bothered by flames and smoke. When the washing is completed, the iron pipes are removed and the water escapes into the soakage pit.

Physical examination of mess personnel. All permanent food handlers must pass a physical examination when first assigned to such duty and thereafter at intervals of six months. Temporary food handlers, ones on duty 24 hours or less, though not required to undergo examination should not be kept on duty if they have any symptoms of a communicable disease. In addition, the personal cleanliness of all mess personnel, including that of their clothing, should be excellent at all times. Any person having any part in the handling of food, who presents symptoms of illness, however mild, should be temporarily relieved from duty.

Care of kitchen utensils. All such utensils after use must be thoroughly cleansed and disinfected by live steam or boiling soapy water. They should be air dried; towels should not be used. This cleansing should be extended to tables on which meat or other food is prepared.

Mess tables. Where tables are used, they should be so constructed that the middle leaf or board may be removed to permit cleaning in the space between the boards and re-

moval of any food particles, or they should be provided with impermeable tops.

Protection of prepared food. Foods should be kept covered prior to and during serving to prevent access of flies. Left over foods which are used subsequently should be recooked This is particularly important in left over meats and potatoes used in the preparation of hashes and salads. Chicken, veal, pork and fish are decomposed rapidly by bacterial action. Unused portions which are to be used later should be kept at a low temperature or reheated prior to use.

Toilet and lavatory facilities. Adequate toilet facilities and provision for washing hands should be readily available to the mess personnel.

Flies. Flies should be prevented from entering mess halls and kitchens by adequate screening kept in good repair. Flies which do get into mess halls and kitchens should be destroyed by swatting and the use of sprays, fly wires, and fly paper. Garbage cans should be kept clean and tightly covered in order that the decomposing food remnants may not attract flies.

Roaches and ants. Sodium fluoride placed in cracks, crevices, and about water pipes twice or three times weekly will, if the kitchen is kept clean, greatly aid in the eradication of roaches. Ants may be destroyed by pouring boiling water or kerosene into their nests. The placing of refrigerator and table legs in cans containing water aids in the elimination of ants.

Proper mess sanitation is maintained only by careful daily inspections and the correction of defects as soon as discovered.

CHAPTER XIV

INSECTS AND INSECT-BORNE DISEASES

General. A disease is classified as insect-borne when a blood sucking insect is the only agent, or the usual one, by which the causal organisms are transmitted from person to person or from an animal to man.

Malaria and bubonic plague may be considered as typical examples of insect-borne diseases. The causal organisms of malaria are transmitted from the blood stream of one person to the blood stream of another by the mosquito. The causative agents of bubonic plague are transferred from the tissues of an infected rodent to the tissues and body fluids of man by the flea.

Diseases of this class are infrequent in the northern United States. In the South they are quite prevalent, malaria in particular being important. In many parts of the world insect-borne diseases are responsible for a great amount of illness and numerous deaths. Insects which transmit disease to human beings are known as vectors.

Transmission of Disease by Insects. The vector of insect-borne disease is primarily infected by biting a person or an animal who has, or is a carrier of, the disease in question, with the consequent ingestion of blood containing the infective agent.

The disease producing organisms are later transmitted to man as a result of biting or an attempt at biting by the infected insect. In the transmission of some of the insect-borne diseases, the infected insect injects the organisms into the tissues of man in the act of biting, either in the secretion from the salivary glands or in material brought up from the digestive tract. Malaria is transmitted by the former and plague can be transmitted by the latter method. In other instances, the surface of the skin is contaminated by the feces or glandular secretions of the infected insect, or by the tissues and

body fluids of an insect crushed on the skin. This infected material reaches the blood of the bitten person by being inoculated into the bite wound or through abrasions made by scratching or rubbing the bitten areas. Typhus fever is an example of this method of transmission. The infective agents of certain of the insect-borne diseases, notably plague and relapsing fever, will pass through the unbroken skin.

Biological transmission. Some of the organisms which cause insect-borne diseases in man must pass through a stage of development in the body of the insect host before they can be transmitted to the human host. There is a biological relationship between the insect host and the parasite and this method of transmission is known as biological transmission. Malaria is an example of diseases which are biologically transmitted.

Mechanical transmission. Where it is not necessary for the infecting organisms to undergo a period of development in the insect host, biting insects may mechanically transfer the infective agents of diseases from person to person or from animal to man. Usually, the diseases which are transmitted mechanically by biting insects are those due to bacteria. Bubonic plague is an insect-borne disease which is transmitted mechanically, but any blood stream infection, theoretically at least, could be transmitted in this manner.

General Prevalence and Importance. The geographical and local prevalence of an insect-borne disease is governed by the distribution and prevalence of the insect host. Consequently these diseases can prevail only in districts where environmental conditions are favorable for their continued maintenance. For example, those species of mosquitoes which are capable of transmitting disease can survive and breed only under favorable climatic conditions and, consequently, mosquito-borne diseases are most prevalent in tropical and subtropical regions and in the warmer portions of the temperate zones. Louse-borne diseases, on the other hand, occur most frequently in cold and temperate regions, as the conditions produced by cold weather favor breeding and spread of human lice.

Where the cycle of transmission includes an animal host of the infectious agent, or of the transmitting insect, the prevalence of the disease concerned is modified or entirely governed by the accessibility of the animal hosts. For example, bubonic plague occurs in man only when plague infected rodents are present, and Rocky Mountain spotted fever prevails only where suitable animal hosts are accessible to the transmitting tick.

Those insect-borne diseases transmitted by insects which are only incidentally or occasionally parastic on man, including the diseases transmitted by mosquitoes, fleas or ticks, are not military diseases in the sense that a military environment, as distinguished from a civilian environment, facilitates their spread, or that their incidence is usually greater in a military population than in the civilian population. But, trench fever, typhus fever and relapsing fever are true military diseases in the sense that they tend to prevail to a much greater extent among troops than in civilian communities. This is due to the fact that the insect host, the human louse, is an absolute parasite on man and that a military environment, especially under combat conditions, favors its continued propagation and spread. Consequently, of the insect-borne diseases, the louse-borne diseases are potentially the most dangerous to military forces.

Insects and Diseases Transmitted by Them

Insect Vector	*Diseases Transmitted*
Mosquitoes	Malaria Yellow fever Dengue Filariasis (Tropical Elephantiasis) Equine Encephalomyelitis
Lice—body lice, possibly head lice	Typhus fever (Epidemic type) Relapsing fever Trench fever
Flies, biting—Glossinae chrysops	Trypanosomiasis Filariasis Tularemia

Midges and sand flies	Pappataci fever (Sand fly fever) Leishmaniasis
Fleas	Bubonic Plague Typhus fever (endemic type)
Ticks and Mites	Rocky Mountain Spotted fever Relapsing fever Tularemia Tsutsugamushi fever
Bedbugs	Relapsing fever (possibly)

Most insect-borne diseases occur in the tropics and subtropics. The increasing activity of the American Forces in these zones makes it important for our Officers to have some knowledge of the control of many of the conditions heretofore considered to be of little concern to our troops.

General Control Measures. Procedures for the control of insect-borne diseases are designed chiefly to control or destroy the insect hosts of the infective agents. Measures may be taken to control or destroy the animals which serve as hosts for the transmitting insects, or as carriers of the causal organisms. In other instances, insect-borne diseases may be prevented by protecting man from the bites of infected insects, or by preventing human cases or carriers from infecting the transmitting insect hosts.

Control of insect hosts. The control or eradication of an insect host may be accomplished either by the destruction of the insect in some one of the stages of its life cycle or by so modifying the environmental conditions that breeding or the continued existence of the adults is prevented.

Insect control measures generally are designed to take advantage of and utilize some characteristic or habit of the insect which renders it vulnerable to attack. In certain instances, control procedures may be successfully directed against the breeding places, while in other situations control can be accomplished most effectively by measures which destroy the insect in the adult stage or during some one of the developmental phases of its life cycle. For example, mosquitoes are controlled mainly by elimination of their breeding

places and the destruction of the larval and pupal forms. The body louse is controlled by destruction of the egg, nymphal and adult forms, or by maintaining conditions, such as cleanliness of person and clothing, which are unfavorable to their continued existence.

Control of animal hosts. The control of those insect-borne diseases in which an animal serves as a reservoir of infection, or as the normal host for the transmitting insects, is effected primarily by the control of the animals concerned. Thus, the spread of bubonic plague is prevented or controlled by the destruction of the rodent which serves both as host for the fleas and as a carrier of plague bacilli. Rocky Mountain spotted fever may be prevented by the control of the animals that serve as hosts for the transmitting ticks and, presumably, as carriers of the causal organisms of the disease.

Discussion of Principal Insect-borne Diseases. Malaria. *Definition.* Malaria is an infectious disease characterized by an intermittent or remittent fever, chills, profuse sweating, and in the more chronic cases, by anemia, weakness, and enlargement of the spleen.

Cause. The cause of malaria is a protozoan belonging to the genus Plasmodium. The life cycle of the malarial plasmodium consists of two phases, one of which, the asexual stage, is passed in the blood of man, and the other the sexual stage, in the body of the Anopheles mosquito.

Mode of transmission. The Anopheles mosquito bites a patient with malaria and sucks the parasites into its stomach. In a period of 12 days these parasites have completed the sexual cycle of their development and appear in the mosquitoe's salivary glands. If the mosquito then bites some susceptible person, such a person will in 10 to 14 days develop the disease. The infected mosquito can transmit the infection during its entire life span and apparently is not harmed by the presence of the plasmodia.

The Anopheles mosquitoes which transmit malaria breed chiefly in natural collections of water, such as open pools, swamps, and puddles. They are nocturnal in their habits, biting but rarely in the bright part of the day. The female only

transmits the disease as the male mosquito is a vegetarian.

Malaria prevails in tropical and subtropical countries, and in warm climates generally. It is most prevalent in the belt between 20 degrees S. latitude and 35 degrees N. latitude. The seasonal variation in the prevalence of malaria is determined largely by the breeding of the insect host. In the southern part of the United States generally, the incidence is the highest during August, September, and October. In tropical countries, the greatest incidence occurs, as a rule, during rainy seasons when climatic conditions favor the increase of the transmitting mosquitoes.

Importance. Because of the breeding habits of the Anopheles mosquito, malaria is essentially a disease of rural sections, rather than of cities or densely inhabited communities. It prevails to a greater or less extent throughout the rural portions of the Southern States, but the incidence varies greatly with the local conditions which influence the prevalence of mosquitoes, or determine the effectiveness of control measures where such measures are employed. Malaria is endemic in Puerto Rico, Panama and the Philippine Islands. There are no Anopheles mosquitoes in Hawaii and, consequently, there is no malaria present.

During peace, malaria occurs among troops stationed in localities where measures for the control of malaria cannot be or are not made completely effective. In malarial districts, such as, for example, the Panama Canal Department, the incidence of malaria is low among the troops that are stationed within the so-called sanitated areas or zones where mosquito control measures are effectively employed. In the great majority of instances, the malaria occurring among troops is contracted through exposure while on duty or on pass in civilian communities.

Malaria is an important disease from a military viewpoint because of the non-effectiveness produced by the disease and by the long course of treatment required to prevent relapses and effect a cure. This fact is well brought out when we consider that one death from pneumonia corresponds to 125 sick days, while one death from malaria corresponds to 2,000 to 4,000 sick days. A man with malaria is half sick all of the time.

Control measures. The control of malaria is based on the following procedures:

1. Elimination of mosquitoes by eliminating their breeding places, by drainage or by destroying their larvae and pupae by means of oil, paris green or fish.
2. Recognition of the disease, with proper treatment.
3. Safeguarding of patients from mosquitoes until their blood is free from parasites.
4. Screening of porches and houses with particular caution at night.
5. Chemical prophylaxis.
6. Protection of man from the bites of infected mosquitoes.

The control of the transmitting mosquito is accomplished by the control of breeding and the destruction of the immature forms and adults. The screening of barracks and the use of mosquito nets in the field are the most important methods of protecting troops from the bites of infected mosquitoes. Head nets and gloves are employed as a means of protection for troops where their activities and the danger of exposure justify their use.

Chemical prophylaxis consists in the administration of either quinine or atabrin in such quantities and at such intervals that the malaria plasmodia injected by mosquitoes will be destroyed before they develop sufficiently to produce clinical symptoms. It has been shown that troops in Anopheles mosquito infested areas so protected are not apt to develop malaria as are those to whom one of these drugs is not given.

Dengue. *Definition.* This disease, also called breakbone fever or dandy fever, is an acute infectious disease. The typical case shows an abrupt onset, severe malaise and depression, pain in the back and extremities, especially in the joints, headache, loss of appetite, and fever. A rash appears on the third or fourth day. Dengue is usually a non-fatal disease but convalescence may be long and accompanied by weakness, physical and mental depression.

Cause. Dengue is caused by a virus which is present in the blood only during the last day of incubation and the first three days of the fever.

Incubation period, susceptibility, and immunity. The incubation period of dengue varies from three to ten days. The usual period is five or six days.

Man is universally susceptible to dengue. Apparently, neither age, sex nor race influences susceptibility, although native races of tropical and sub-tropical countries may exhibit a high group resistance because of acquired immunity.

One attack of dengue tends to confer permanent immunity to the disease. Second attacks may occur, but are relatively rare and are less severe than primary infections. It is probable that, in most instances, the conditions which have been diagnosed as second attacks of dengue have been in reality due to some other infection.

Prevalence and importance. Dengue tends to occur as explosive epidemics and pandemics. The epidemic characteristics of dengue are due chiefly to the high susceptibility of the non-immune individual and to the habits of the transmitting insect host, which is essentially domestic and lives in close association with man.

The distribution of dengue is limited geographically by the distribution of the special mosquito carriers. It occurs throughout the tropical and sub-tropical regions of the world generally, and is common in the West Indies and the Orient. Widespread epidemics have occurred in the southern part of the United States.

Dengue is more prevalent in urban or thickly inhabited districts than in rural regions, due to the limited range and domestic habits of the transmitting mosquito.

While dengue is a non-fatal disease, it is, nevertheless, important from a military viewpoint because of its influence on the effectiveness of the individual and the potential danger of epidemics which would render entire units non-effective for considerable periods of time.

Transmission. Throughout the world generally, dengue is usually and most commonly transmitted by Aedes egypti. Recently, it has been found that Aedes albopictus is capable of

transmitting dengue in the Philippine Islands.

The source of infection is the person having the disease, and, as far as is known, there are no human or animal carriers of the infection.

The mosquito cannot transmit the disease until eight to eleven days after becoming infected and then remains infectious for life and is not injured by the presence of the virus.

Control measures. The control of dengue is based primarily on the control of the mosquito transmitting the disease.

Aedes egypti breeds by preference in or near human habitations and will remain in houses or barracks continually throughout its life span. It apparently prefers the blood of man to that of the lower animals and is a persistent and vicious biter.

As Aedes egypti are daylight biters, the control measures designed to eradicate them from buildings occupied by troops should include not only barracks and quarters, but also messes, offices, storerooms, or other places where men work.

When dengue is present in a command, or the troops are subjected to exposure in neighboring civilian communities, any man complaining of illness should be regarded as a dengue suspect.

Yellow fever. *Definition.* Yellow fever is an acute infectious disease, characterized by sudden onset, severe headache, pain in the lower back, a moderately high fever and a slow pulse, jaundice, hemorrhages from the stomach (black vomit), weakness, and an infection of the kidneys.

The case fatality rate as reported varies greatly in different epidemics but it is usually between twenty and thirty percent. This rate is probably high because of the many missed mild cases.

Cause, incubation period, susceptibility, and immunity. The casual agent of yellow fever is a virus. The incubation period varies from two days or less to six days, but is usually between three and five days. Man is universally susceptible to yellow fever regardless of age, sex, or race One attack of yellow fever confers permanent immunity to future infections.

Prevalence and importance. In 1793 yellow fever killed 10 per cent of the population of Philadelphia. Now the disease is rarely seen in this country. In 1900 the American Yellow Fever Commission, consisting of Reed, Carroll, Lazear and Agramonte, proved beyond question that this disease is transmitted by a species of mosquito, Aedes egypti, and that these mosquitoes cannot transmit the disease until twelve or fourteen days after having sucked the blood from a yellow fever patient in the first three or four days after the onset of symptoms. The mosquitoes remain infected for life and are apparently uninjured by the presence of the infection.

In recent years yellow fever was found to exist in the jungles of South America and Central Africa. In these areas the disease is transmitted by forest mosquitoes and not the Aedes egypti. One type is characteristically an inhabitant of the tree tops thus considerably complicating the problem of control.

Control measures. The prevention of yellow fever depends primarily on the extermination of the mosquito by which it is transmitted, a task which compared to the extermination of the Anopheles mosquito is relatively simple because the Aedes egypti breeds almost exclusively in artificial containers located in the vicinity of human habitation; the patient is infective only during the first three or four days of the disease, and the persons who have the disease are prostrated. The female only transmits the disease and does not produce eggs until it has had a meal of blood, preferably human blood. This fact probably accounts for the domesticity of this mosquito.

The presence of a reservoir of virus of yellow fever in the jungle and the development of fast airplane travel adds to the problem of control. An effective vaccine has been developed and Army Regulations require that every member of the Armed Forces be protected with it.

Typhus fever. *Definition.* Typhus fever is an acute infectious disease characterized by a sudden onset, continued fever for thirteen or fourteen days, stupor, delirium, and a rash which appears about the fifth day.

Cause, incubation period, susceptibility and immunity.

Typhus fever is caused by minute parasites spoken of as Rickettsia. These organisms are transmitted most commonly by the louse. In the mild or endemic form of typhus they are transmitted, however, by the flea. The incubation period of typhus fever is usually about twelve days, but may vary from five to twenty days. Man is susceptible to typhus fever without regard to age, sex, or race. One attack apparently confers definite and lasting immunity.

Prevalence and importance. There are two types of typhus fever, the mild or endemic form and the severe or epidemic form. Epidemic typhus fever occurs under environmental conditions which promote infestation with lice. In armies, it occurs chiefly where troops are concentrated under combat conditions for relatively long periods of time. Formerly, typhus fever was prone to occur as extensive epidemics among beseiged and beseiging armies.

Among civilian populations, epidemic typhus fever occurs most frequently during famines, or during or following disasters or social upheavals which produce an environment in which lice will spread. Cases of the mild or endemic type occur among persons exposed to rats. This form of typhus is spread through the faeces of the rat flea.

At the present time, the most important typhus fever areas are Central Europe, Spain, Russia, Northern China and Indo-China. The mild form of the disease occurs in the United States, especially in the southern and south-eastern portions and along the Atlantic Coast.

Control measures. The control of epidemic typhus fever among troops is based on the control of lice, which is considered in detail later. A vaccine is now available. The protection afforded lasts about six months. All army personnel going into areas where there is danger of contracting typhus must be vaccinated against the disease.

Rocky mountain spotted fever. This disease resembles typhus fever in many respects. It is characterized by fever, severe pains in the back and a skin rash. One attack confers life-long immunity.

The disease occurs only in the United States. For many years it was seen only in the Northwest, principally in Montana and Idaho, but it has recently appeared in the Eastern United States. There occur about five hundred cases in this country each year. Mortality from the disease is greatest along the western bank of the Bitter Root River in Montana, it being fatal in about 80 per cent of the cases. Elsewhere the mortality seldom exceeds 25 per cent.

Certain small rodents constitute the reservoir of this infection; rabbits, prairie dogs, woodchucks, and squirrels being the principal ones. From these animals the disease is conveyed to man by the bite of the wood tick. Formerly this tick was thought to be the only vector, but recently the dog tick and other species of ticks have been found to be transmitting agents. The disease prevails during the late spring and early summer months, which is the period of greatest activity of the immature forms of the tick.

Control. Control of this disease is based upon control of the tick and its animal hosts. One does not usually feel when a tick is biting. A person is always surprised when he finds a tick attached. Force should not be used to remove the attached tick, otherwise the mouth parts will be left behind in the skin. The following procedure is advocated: A small camel's hair brush should be dipped in turpentine, benzine, gasoline or kerosene and applied between the skin and the under surface of the tick. After a few minutes the tick will let go its hold, being killed by the application, and may be swept from the skin with the brush. It is best for a Medical Officer to be asked to remove the mouth parts if forcible removal has been unsuccessfully attempted.

A tick may loosen its hold and drop to the ground if a lighted cigarette is applied close enough to make it uncomfortable. Repellants such as powdered sulfur or pyrethrum dusted on underwear and socks may have some value. It should be remembered that the skin of some individuals is too sensitive for the use of these agents.

The control of Rocky Mountain Spotted Fever over a wide area by the control of the tick vectors has been discouraging. Some local good has been accomplished by dipping of cattle in arsenic dips; in clearing land and cultivation; grazing control; and the control of rodents.

The avoidance of tick bites is urged by keeping out of known tick infested areas during spring and early summer; or by wearing of suitable clothing, such as high boots, leggings or putties. The early removal of ticks minimizes the danger of infection.

A vaccine is in use as a preventive measure in Rocky Mountain Spotted Fever. The degree and duration of protection vary with the person vaccinated and with the degree of virulence of the infectinb strain of the spotted fever virus. The average person vaccinated in the spring retains immunity during at least the remainder of the year.

Relapsing Fever. This name is given to any one of several closely related diseases characterized by attacks of fever lasting about a week and recurring in like intervals. Various spirochaetes cause the disease. Susceptibility is general. Epidemics vary greatly in intensity. In time of war amongst starved and debiliated communities, relapsing fever tends to be a serious disease, and the mortality rate, usually slight, may be very considerable.

Body and head lice and various species of ticks transmit the disease. There is a possibility that bed bugs may also be vectors. Control should center around the elimination of these insects.

Trench Fever. This name is given to a relapsing type of fever which was first reported amonst the troops in France in the war of 1914-1918. It disappeared soon after the last war and has not yet returned. It is caused by a Rickettsia which is transmitted by the body louse. Although it is not a fatal malady, it is a very disabling one and can take large numbers of troops out of action for long periods of time.

Filariasis. This disease is prevalent in all tropical countries. Long, slender worms, or filaria, are the causative agents. These worms enter the human body in the larval

stage through the bite of an infected mosquito. Species of Culex and Aedes are the chief carriers. The adult worms live in the lymphatic vessels, connective tissue and body cavities. The adult worms and their eggs block the flow of lymph causing tremendous swellings (elephantiasis). The prevention of a filarial disease resolves itself around the eradication of the mosquito and protection of the troops from the bites of mosquitoes. Filariasis exists in malarial districts and often the two diseases are found together. It is therefore quite possible—by a strong anti-mosquito campaign—to kill two birds with one stone.

Sand Fly Fever. This is an acute non-fatal dengue-like disease characterized by a sudden onset and a short duration. It is sometimes called "three-day fever." It is caused by a virus which is transmitted by a small hairy midge about the size of the head of an ordinary pin. There may be a long convalescence from this disease. Newcomers to tropical or semi-tropical countries in which sandfly fever is endemic are more susceptible to the disease than others. One attack gives a lasting immunity. Control is achieved by the eradication of the midges which is rather difficult and the protection of the individual from bites of these insects.

Plague. The plague is a very serious infectious disease primarily of rats and other rodents and only secondarily of man. Plague is world-wide in its incidence. The disease is found wherever rats are prevalent. Epidemics usually occur in seaports where rats are always numerous. Central Asia and Northern China have served as foci of infection for ages. India and Burma are the most active foci at present. An endemic center in our own country exists in California where the ground squirrel has become infected. The causative organism is the bacillus pestis. In the bubonic form of the disease the bacillus is conveyed from rat to man mainly by the rat flea. Animals other than rats may serve as the reservoir of infection, particularly squirrels.

It is now recognized that certain forms of merchandise, especially grain and to a lesser extent raw cotton, because

of the transported rats and fleas, are to be dreaded as vehicles of plague infection.

Pneumonic plague, a very severe and fatal form of the disease involving the lungs, is transmitted from the sick to the healthy by droplets of sputum expelled during forcible exhalations.

The eradication of rats and other infected rodents provides the best means of prevention and control of this disease.

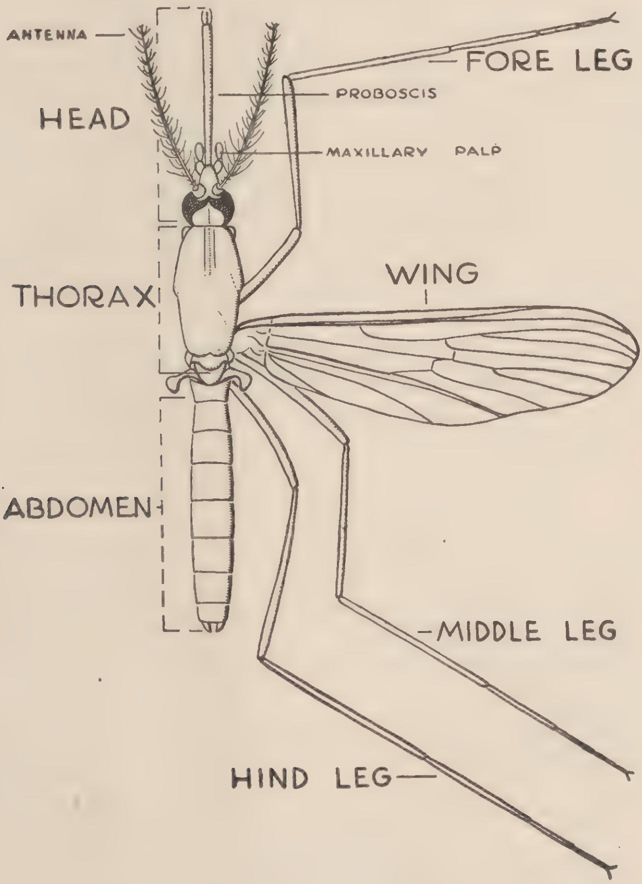

Fig. 50. Mosquito. Gross anatomy.

When the rats become ill or die of the disease the fleas leave them to attack man. Elimination of fleas is therefore an important auxiliary measure. A vaccine has been made available which is protective for about six months and it is required that all army personnel, exposed to the threat of plague, be immunized.

Insect Control. Physical characteristics of mosquitoes. In some instances mosquitoes may be difficult to recognize but one can be fairly sure that an insect is a mosquito if it has a long slender body consisting of three parts: the head, thorax, and abdomen; two thin transparent wings with fringe on the rear edge; six long slender legs; two antennae or "feelers"; a proboscis which is about the length of the head and thorax; and two palpi or mouth parts. (Figs. 50, 51 and 52).

Life cycle. Mosquitoes develop by complete metamorphosis, the life cycle consisting of the egg, larval, pupal, and adult stages. The egg, larval, and pupal stages are passed in water while the adult stage is represented by a free flying insect. Males are vegetarians. Females are blood suckers and thus act as transmitters of disease. The time for development of the egg to the larva is 3 days, of the larva to the pupa 10 days, and of the pupa to the adult 3 days. This varies somewhat with the climatic conditions. The adult generally lives from one to three months. The larvae are commonly called "wrigglers" or "wiggle-tails" and the pupae "tumblers."

Culex, Anopheles, and Aedes mosquitoes are concerned in the transmission of disease. It is to their eradication that we devote most of our attention. The egg, larval, and adult stages are easily identified.

Important distinguishing characteristics.

1. Culex.

Eggs—Cemented in rafts. Lie on the surface of water.

Larvae—Hang at an angle in the water.
Feed below the surface of the water.
Breathe at the surface through a long, slender breathing tube attached at the rear of the abdomen.

Adult—In the resting position the body is parallel to the surface.
Wings have no spots.
Head of the female has short palpi.

Fig. 51. Antennae of various types of mosquitoes.

2. Anopheles.

Eggs—Are boat shaped, lie singly on the surface of the water in star or triangular patterns.

Fig. 52. Mosquito wing.

Larvae—Lie parallel to surface of the water.
Feed at surface of the water.
Breathe at the surface; have no breathing tube.
Have a breathing stoma or opening on rear of the body.

Adult—Resting position is at 45-degree angle to the surface.
Wings are spotted.
Head of the male and female has long palpi.

3. Aedes.

Eggs—Lie singly on the surface of the water.

Larvae—Hang at an angle in the water.
Feed below the surface of the water.
Breathe at the surface through a short barrel-shaped tube attached at the rear of the abdomen.

Adult—Resting position is same as the Culex.
Wings have no spots.
Head of the female has short palpi.

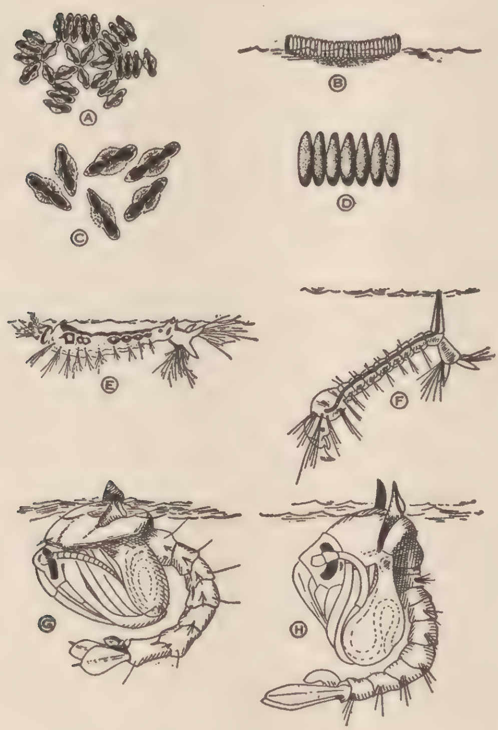

Fig. 53. Life cycle of mosquito. A—Eggs of Anopheles mosquito. B—Eggs of Culex mosquito, (egg raft). C—Eggs of Anopheles mosquito showing floats. D—Eggs of Culex mosquito. E—Larva of Anopheles mosquitoe. F—Larva of Culex mosquito. G—Pupa of Anopheles mosquito. H—Pupa of Culex mosquito. (From Dunham's Military Preventive Medicine.

4. It is difficult to differentiate between genera in the pupal stage.

5. Practically all mosquitoes breed in comparatively still water, such as slow moving streams, ponds, marshes, swamps, drains, water receptacles, and roof gutters. However, individual species have characteristic breeding places and habits.

Habits.

Anopheles—bites at dusk, night, and dawn.
Culex—bites at dusk, night, and dawn.

Fig. 54. Resting position of mosquito. Culex above; Anopheles below.

Aedes—bites during the day.

Anopheles are classed as wild mosquitoes; one looks for breeding places away from habitations. Culex and Aedes are domesticated. Their breeding places are often near and in human habitations.

Relation to diseases.

Anopheles—transmits malaria.

Aedes—transmits dengue, yellow fever, and filariasis.

Culex—transmits filariasis.

All mosquitoes are pests and because of their biting habits interfere with the rest of troops, hence lower morale and efficiency.

Control measures. Eliminate breeding places. To be applied only in semi-permanent or permanent camps.

1. Filling is cheap and effective. It is the most practical for small storm water areas. One can use earth, rocks, garbage, cinders, ashes, rubbish, and old manure as fill.

2. Drainage. Surface drainage can be accomplished by open U-shaped ditches to remove standing or storm water. This type requires attention to keep out vegetation. Subsurface drainage can be simply accomplished by a trench filled with rock two inches to six inches in size. (See Fig. 55, which shows drainage ditches used in mosquito control).

3. Policing of streams. Straighten bends, remove pot holes, and underbrush. Police edges back for four feet.

4. Empty water containers weekly.

Destruction of larvae. Larvacides such as crude oil, waste motor oil, kerosene, and Paris green are used as follows:

1. Oiling is a temporary measure. Light fuel oil (usually designated as No. 2 fuel oil) is recommended since it is easily handled in large or small spraying equipment and is economical in cost. Waste crankcase oil is unsatisfactory unless it is strained and mixed with kerosene in the proportion of one part of waste motor oil to three parts of kerosene. One must maintain a film on the surface of the water for two to three hours in order to kill larva. Approximately 20 gallons of oil should be sprayed over each infested acre of water

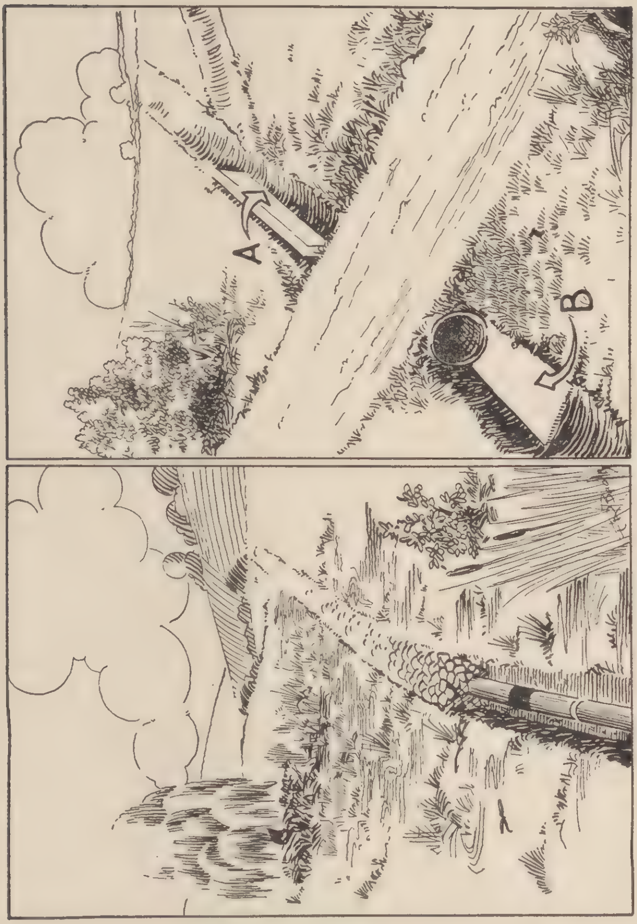

Fig. 55. Drainage ditches. A and B are splash boards.

surface. Depending on the difficulty in covering the area, a laborer using a knapsack sprayer can treat one to four acres in eight hours. In heavy breeding waters it is usually necessary to apply the oil at seven day intervals.

Soap emulsions of pyrethrum extract in kerosene oil are more useful larvicides than ordinary oil films and are less harmful to vegetation, fish and wild life.

The following oiling methods may be used:

a. The knapsack sprayer consists of a container for the larvicide, a pump and a spray nozzle. It holds about five gallons and is operated by one man who carries the sprayer strapped on his back. Range, 25 feet. It is used for small ponds, pools and ditches.

b. Watering can method is a hand method, slow but effective. The nozzle should be fixed so that the larvicide is not wasted.

c. The drip oiler is used in slow moving streams. It keeps a good film over indentations in stream banks and over stream eddies. It requires little attention. The oil must be adapted to the temperature. The oiler is made from a container, such as a galvanized iron can, 5-gallon oil can, or bucket. A hole is made in the bottom of the container. A nail is wrapped with gauze and inserted through the hole. This acts as a wick or regulator. Place the oil in the can and set it on boards over the stream to be oiled. Regulate the flow so that just enough oil drips to form a film over the stream surface. Twenty drops per minute for each foot width of the stream is the usual quantity required. The oiler may be placed on a moored raft or float.

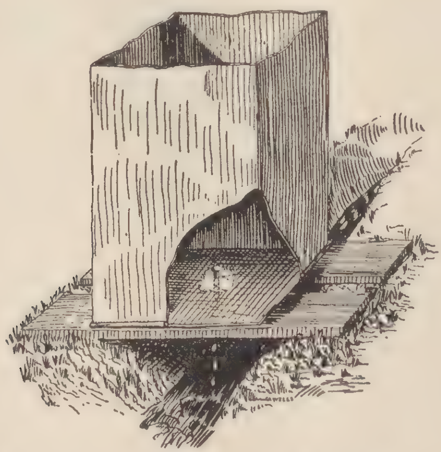

Fig. 56. Drip oiler made from five gallon oil can. (From Dunham's Military Preventive Medicine, 3rd Edition).

d. Submerged oiler. Fill an ordinary burlap grain sack with oil-soaked sawdust; weigh down with rocks to sink and moor it. Place sack in the stream. Oil comes off gradually and maintains a film for about one week.

2. Paris green. Mix one part thoroughly in 100 parts of road dust. Apply to lakes, ponds, or streams by hand casting. It may also be spread by a blower or from an airplane. This procedure is only of value against the Anopheles mosquito larvae. Apply every week to prevent development of new larvae. One-half ounce of Paris green diluted with 100 times its volume of road dust will be sufficient for 1,000 square feet of water sur-

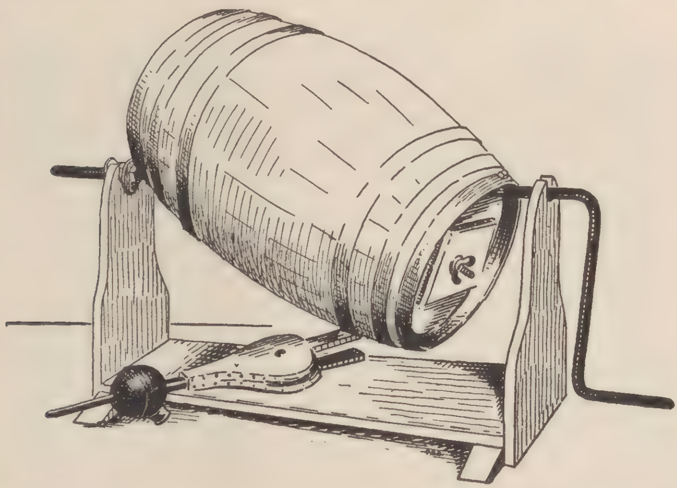

Fig. 57. Equipment for mixing and applying Paris green larvicide.

face. In this amount it will not harm fish. While this spray is poisonous because of the arsenic contained, it is not dangerous for men to handle. The spray is difficult to use in vegetation and to apply during rainy, damp weather. Paris green diluted with damp sand is effective against sub-surface feeding species.

3. Stock slow-moving streams or ponds with fish that eat larvae.

Destruction of adults. Swatting is of most value at twilight

and just after daybreak. Mosquitoes collect on screens, doors, and windows. Use the ordinary fly swatter.

Spraying is of value in buildings. The following is a good spray:

Kerosene—pyrethrum extract .... (The extract of two pounds of pyrethrum flowers containing a minimum of 0.9% pyrethrins)	2 gallons
Liquid coconut oil soap	8 ounces
Water	1 gallon

Mix well. To use, dilute ten times with water and spray it on the walls with a small spray pump.

Fig. 58. Hand duster blower for Paris green. (From Dunham's Military Preventive Medicine, 3rd Edition).

Protection of the individual. Screening is of value if maintained perfectly otherwise it is useless. Eighteen mesh openings to the lineal inch are required to keep Aedes mosquitoes out. Screen doors should open outwards and be on good spring hinges. Vestibules, if screened with double doors, are useful.

Mosquito nets are to be used on beds in all areas where mosquito-borne diseases are present, when screening of buildings is impossible or inadequate or when sleeping in tents. Their use must be enforced by the unit commander. They may be used on T bars or suspended from the inside or over the outside of the shelter tent. No part of the net should touch the sleeper. Men must tuck nets in on all sides before going to sleep. During daytime nets must be rolled. The nets should be inspected regularly for holes, ripped seams, and tears. Nets are to be carried as part of the soldier's equipment in malarial countries. Use head net and gloves for members of the guard and others on duty outside when Anopheles mosquitoes are prevalent.

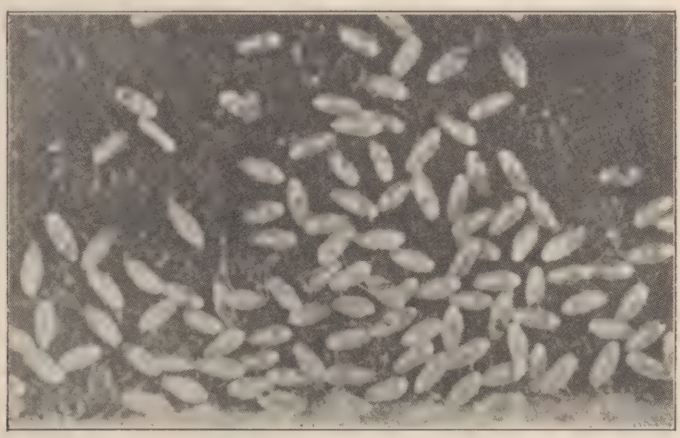

Fig. 59. Eggs of body louse. (Courtesy Army Medical Museum).

Army Regulations provide that in areas where malaria is highly prevalent, especially if screening is lacking, prophylactic drugs can be administered in an emergency as a preventive measure. Quinine or atabrin prophylaxis does not prevent the development of a certain number of parasites in the blood stream. It will not, in the presence of heavy infections or long continued or repeated exposures, prevent the occurrence of a certain number of cases of malaria. Quinine or atabrin prophylaxis will, however, when properly

administered, prevent a moderate number of plasmodia from developing to a point where they are present in the blood in sufficient numbers to produce clinical symptoms of malaria and thus incapacitate the individual for duty. Chemical prophylaxis will therefore obviate noneffectiveness and keep men on duty who would otherwise be hospitalized for malaria. Quinine is given in doses of five grains daily preferably before evening mess. Atabrin is given in doses of three grains

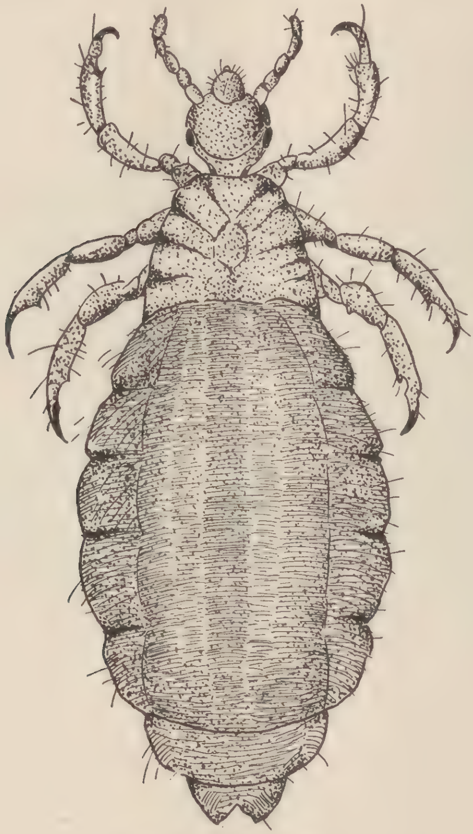

Fig. 60. Body louse.

every three days. These drugs should be administered by roster in the presence of an officer.

Mosquito repellants are of questionable value. Oil of citronella rubbed on the skin will give some temporary protection. The British during their operations on Narvik in 1939 issued the following cream which was used with some success to protect against the hordes of mosquitoes which were present:

Oil of citronella	18.25 percent
Camphor	1.00 percent
Oil of cedar wood	9:00 percent
Paraffin, hard	26.75 percent
Paraffin, soft white	45.00 percent

The Louse. The life cycle of the louse consists of three stages: the egg, larva, and adult. The time for development of the egg is 6-16 days; the larva, 9 days. The adult lives about 30 days.

Egg stage. The eggs are opaque and yellowish, ovoid in shape, and about one millimeter in length. They are attached to the clothing and to hairs of the body by a cement excreted by the female.

Larval stage. The larvae are whitish in color and pinhead in size. For their existence they require blood within 24 hours after development and each day. Physical characteristics of the larva are the same as the adult but the larva is smaller.

Fig. 61. Crab louse.

Adult stage. The adult begins to lay five to ten eggs daily within 24 hours after development and continues to survive for 30 days under favorable conditions of food and tem-

perature. One female can produce 4,000 offspring in a month. The adult is 3/16-inch in length and is covered with a hard coat carrying bristles.

Habits. Through development and environment the louse has become adapted to various parts of the body. The head louse has sought the hairy head of man, the body louse the body, and the pubic louse the genital region. The nits or eggs of the head and pubic louse are found firmly cemented to the hairs of the head and pubis respectively. The eggs of the body louse are attached to fibers of cloth in the seams, and also to body hairs. The body louse will die of starvation if separated from its host and thus deprived of human blood.

The pubic louse will die in two days if separated from its human host.

Lice are greatly affected by heat and cold. The optimum temperature for their activity is between 86 and 90 degrees F. At low temperatures they become moribund and die slowly.

At 98 degrees F. they are very active and can live but two days without food. They are extremely active at 104 degrees F.

Dry heat at 131 degrees F. for 30 minutes and at 140 degrees F. for 15 minutes and boiling water for 30 seconds will destroy adult lice and eggs.

Dissemination. Lice migrate from person to person in crowded sleeping quarters. Eggs are carried through exchange of blankets or clothing. Pubic lice are ordinarily transferred during sexual intercourse and to a slight extent from latrine seats, blankets, and clothing. Eggs may be dropped off the body in straw, debris, and dust or on blankets, latrine seats, and clothing and thus transferred to other persons.

Disease relation. Lice transmit the causative agents of typhus, trench, and relapsing fevers, ingesting the infective agents as they feed upon patients and excreting it in the fecal material. These insects are voracious feeders. They require blood meals frequently and defecate freely while feeding. They desert the body of a patient when his temperature is high or death ensues and seek a new host. The infective agents are not transmitted in the act of blood sucking,

but is carried into the skin by the scratching caused by irritation of the bite.

Control measures. The principal control measure is eradication of the louse. When infestation occurs in the presence of louse-borne disease, methods must be used which will kill the louse and the disease-producing virus as well. Delousing must be 100 per cet effective throughout the command. During peacetime only people living in overcrowded insanitary dwellings are infested. In war, where there is

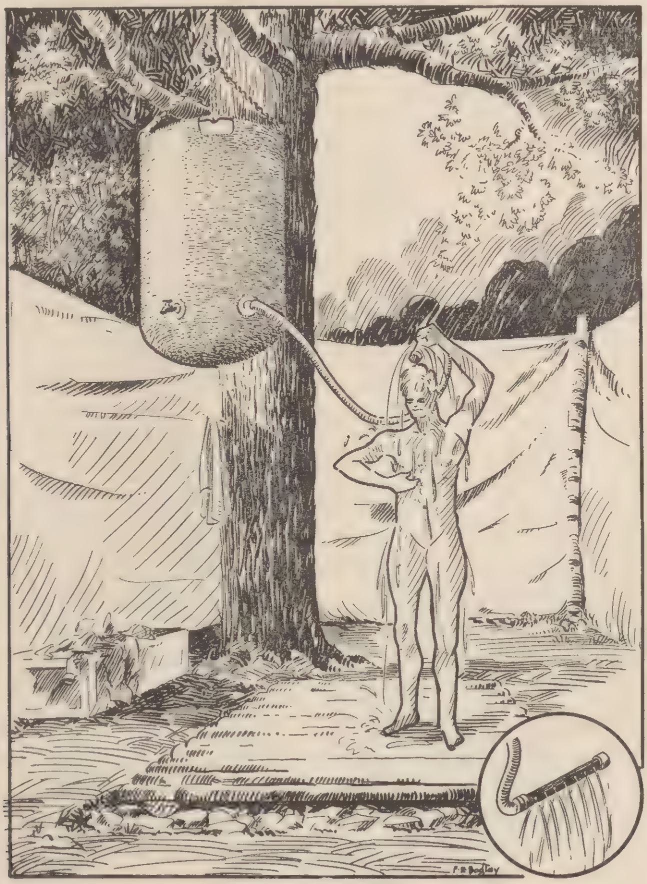

Fig. 62. Shower bath improvised from water sterilizing bag.

necessarily overcrowding, conditions are ideal for lice to flourish. It is, therefore, necessary to carry on wholesale delousing at regular intervals.

In order to be effective measures for the control of lice must accomplish disinfestation of both the individual and the unit to which the infested man belongs. Any slip in the procedure makes the entire measure unsuccessful.

During peace an individual found lousy should shave all hairy parts, except the head, and thoroughly bathe with the use of kerosene soap made as follows:

Boil 1 part of soap in 4 parts of water.
Add 2 parts of kerosene.
Mix with 4 parts of water.

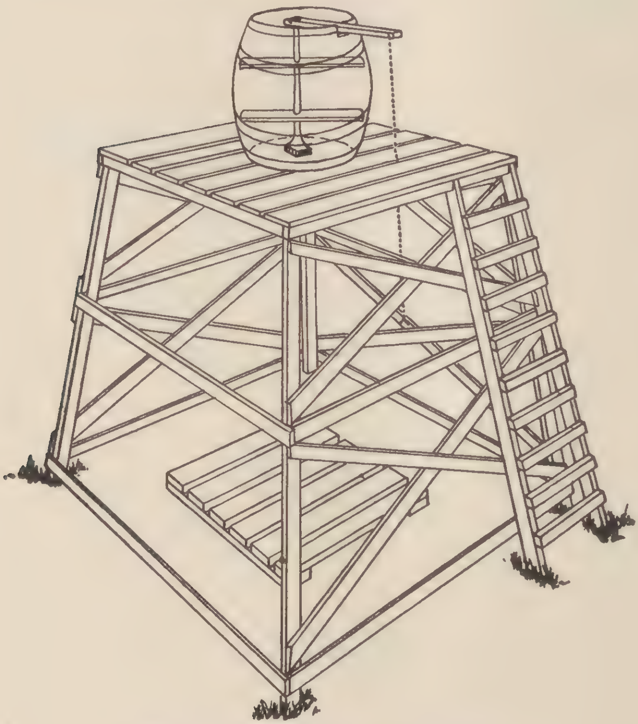

Fig. 63. Improvised shower bath.

A simple device for bathing can be made from a water sterilizing bag suspended from a scaffold or a tree limb. One faucet of the bag is replaced by a rubber tube in the end of which is placed a short section of pipe closed at one end and perforated in numerous places to act as a shower head. A stone filled soakage pit should be constructed underneath the shower and covered with boards on which the men may stand.

If head lice are present, disinfestation can be accomplished by shampooing the scalp with hot, soapy water containing 25 percent kerosene. This removes the detached eggs and kills the adult and larval forms. After shampooing, the hair should be combed with a fine toothed comb to remove any nits not removed by washing. Where practicable the hair should be clipped short. This entire treatment should be repeated in ten days.

Clothing of the infested man should be treated in a pressure sterilizer or, if such is not at hand, a Serbian barrel may be used. Clean clothing should be issued in lieu of disinfestation of old. One month of storage of infested clothing will kill all eggs, larvae, and adult lice.

In any command, war or peace, every man joining or leaving that command should be inspected and, if found lousy,

Fig. 64. Serbian barrel.

should be disinfested. Company officers should conduct a weekly inspection for lice.

During war and in the theatre of operations routine delousing programs should be conducted. Large mobile disinfestors can be used which makes it possible to delouse an entire division in a week's time. At embarkation and debarkation points smooth functioning, elaborate delousing plants are usually constructed.

The principles underlying delousing are: Destruction of lice; destruction of eggs; destruction of the virus of louse-borne diseases; through cleanliness of person and clothing.

Fig. 65. Serbian barrel

Methods of treating clothing. After removing as many lice as possible by hand the clothes are pressed with a flat iron. This method is quite effective but too time consuming except for individuals.

When practicable, clothing made of cotton, linen, and silk may be boiled for five minutes.

Leather belts, shoes, and hats which cannot be disinfested by other means should be immersed in a 5 per cent cresol solution for 30 minutes. Leather goods seldom need disinfestation, however.

Disinfestors of the Serbian barrel type usually consist of a barrel or a similar container for the material to be disinfested, below or in the lower part of which is a receptacle for water and an improvised furnace or fire box.

The galvanized iron garbage can is usually the most practicable, as no separate container for water is necessary. Water to a depth of about two inches is placed in the bottom and the can placed over a cross trench in which a fire is built. A wooden grate supported on sticks about one foot in length should be placed in the bottom of the can to hold the clothes above the water. Hooks on which to hang the clothes may be bolted or riveted into the lid, or S-shaped wire hooks may be hung over the edge of the can. Clothing should be left in the can for 45 minutes after steam commences to escape. Air dry after removal and reissue to the men. This method will kill all the eggs, larvae, and adult lice. During this 45-minute period all men should be thoroughly bathed, using plenty of kerosene, soap and warm water.

Storage may be used where practicable. Store in a dry place for 30 days, keeping an accurate record of time. Once clothes are placed in storage nothing should be added or removed until at least thirty days have elapsed from the date of the last addition.

The Chigger. Chiggers, red bugs, jiggers or harvest mites, as they are variously called, are the larvae, or the first active stage of a large scarlet soil inhabiting mite. They do not carry disease but they produce extreme annoyance by their bites. They are most troublesome in our Southern States.

They are just large enough to be readily seen with the naked eye. They crawl about rapidly. When engorged the body becomes distended and about 1/32 of an inch in length. As soon as engorgement takes place the chiggers drop off and later, on the ground, molt their skins. The subsequent stages of the mites are not injurious in any way. They live as scavengers on decaying vegetation. The mites become full grown in the Fall and burrow in the soil from ¼ to 1 inch and remain there during the winter. In the Spring they deposit a mass of eggs. These hatch several weeks later and the young apparently live several months if they do not find a host.

Chiggers do not burrow into the skin. They attach to the skin usually close to a hair, and inject an irritating secretion which continue to cause severe itching for several days after they have dropped off or been removed. Normally, the chiggers become engorged in four to six days and drop off, but in case of man they are usually scratched off within a day or two after the itching begins.

Control. Eradication of the mite itself is difficult. Cutting brush and grass around buildings is an aid. Applying a dust of of 325-mesh sulfur in connection with the clearing of vegetation helps also. The sulfur should be applied at the rate of 50 pounds per acre by means of a dust gun. This should be repeated 2 or 3 times at 2 week intervals at the beginning of the chigger season.

Protection of the individual is important. Chigger infested areas should be avoided. Colsely woven clothing, trousers tucked into high boots or use of heavy leggings will prevent the entrance of many chiggers. The use of sulfur, dusted on the underclothing and inside the trousers seems to be the only effective repellent.

Treatment of those infested should be prompt. The irritation and itching caused by the bites may persist for 5 to 10 days. A bath in hot water, preceded by a thorough lathering with sulfur soap will get rid of those mites remaining on the body. If infestation is particularly bad a light application of kerosene or pyrethrum-kerosene extract allowed to remain on the body for 2 or 3 minutes and then followed by a thorough bath is effective. A prolonged cold shower helps to reduce the itch and local burn-

ing. A salt water bath or application of mentholated ointments also helps. Scratching should be guarded against because of the danger of secondary infections.

The Jigger. The jigger or the sand flea Tunga Penetrans has a host of local names which are very confusing. It is sometimes also called the chigger or chigoe and this confuses it with our own American chiggers which are the larval or six-legged stage of a large scarlet velvet mite. The jigger is a flea rather like the common flea but smaller and it does not possess the same jumping powers. It is found in the tropical and subtropical regions of North and South America, also in the West Indies and Africa.

The life history and habits of the male jigger flea closely resemble those of the common human flea (Pulex irritans) in this country, but the female furnishes a remarkable example of a free living blood sucker, becoming for the latter part of her life a fixed parasite. She jumps from the ground on to the bare foot of the person attacked and, having obtained her blood meal, burrows into the skin, usually on the under surface of the toes or junction of the nail with the skin. The female flea ceases to burrow when the last abdominal segments are almost level with the skin surface; the fertilized ova now develop, with great rapidity and distend the abdomen to a relatively enormous size so that the flea, which was originally a minute flattened creature only 1.2 mm. in length, becomes within a little more than a week a globular object often 6 mm. in diameter. From now on the eggs are steadily discharged from the vagina, which protrudes from the skin, and fall on the floor or ground one by one. The process of egg laying lasts from a week to ten days, during which time 150-200 eggs are deposited. Once the parent flea has completed the function of egg production she dies and her shrivelled carcass is eventually sloughed out of the wound in the skin. The eggs hatch into larvae in three to four days. The larvae spin cocoons, from which in 8 to 10 days the fleas emerge.

These fleas can become a serious pest to soldiers operating in areas infested with them. The feet are the parts most commonly infested. As troops often sleep on the ground, other

regions are often affected. As a rule, only one or two jiggers are found at a time but large numbers may be present. Indeed the sole of the foot may be honey-combed with them.

Control. Whenever possible camps should not be set up in jigger infested localities. Hence, the neighborhoods of native villages should be avoided. The ground should be swept and, if necessary fired. The floors of tents and huts may be sprinkled with an insecticide. Flaked napthalene is good, or a strong infusion of native tobacco. The latter may be used inside boots and shoes. Walking barefoot and sleeping unprotected on the ground should be avoided. A daily foot inspection must be made by the medical officer and strict attention paid to cleanliness of the feet. The following method of preventing the jigger from gaining entrance to the skin is recommended: Wash the feet thoroughly and then rub in a mixture consisting of 5 drops of lysol in 1 ounce of vaseline. Special care should be taken to treat in this way the spaces between the toes and the under surface of the toes. It is said that this method will afford protection for three days. It has also the advantage that any jiggers which have penetrated the skin before its application are killed and can be more easily and painlessly extracted than when alive. Some natives are expert in the removal of jiggers and their services should be used except that they must be taught to use antiseptics in conjunction with their manual dexterity.

The Rodent Fleas. Rodent fleas transmit Bubonic Plague and endemic typhus to man. Of particular importance are the Oriental rat flea, the European rat flea and the mouse flea. Cat and dog fleas and the human flea must not be overlooked as possible vectors.

For breeding, all fleas must have access to warmblooded animals. Adult fleas lay their eggs in the fur and feathers of the animal host. These eggs drop off and lodge in the sleeping quarters of the animal, or in cracks in floors, out-of-doors on the ground, etc. The eggs hatch in a few days into larvae,—small wormlike creatures which subsist on the debris found on the floor or ground. In two weeks or more the larvae become full-grown and enclose themselves in tiny cocoons in which they transform to adult fleas in the course of a few days or longer.

When the adult stage is reached, the new crop of fleas apparently "born hungry" become quite active in search of food, although they may subsist for weeks without nourishment.

Control. To effectually combat fleas, it is essential to determine the source of infestation, to treat or destroy the animal host, and to destroy the immature stages in the dust on floors or in the burrows of rodents.

To clean up infestation in buildings, a very effective method is a light spraying of creosote oil without dilution. It should be used only when there is no danger of burning animals and plants with the oil. For control in living quarters flake naphthalene is advised. Treated rooms should be left closed for at least twenty-four hours. The floors should be sufficiently well-covered to make them white in appearance and after treatment the naphthalene may be swept up and used in another room.

Rat fleas are most effectively combated by desrtoying the rats and mice with poison baits, traps or by fumigation.

Individuals may be protected from fleas by the use of fresh pyrethrum powder as a repellant. This powder may be sprinkled on the underwear and socks and on the bedding when there appears to be danger of being bitten. Cots and beds may be isolated from fleas by setting the legs in tin covers containing water or a little kerosene and by exercising care not to let the bedding get near the floor.

Phlebotomus Flies. Phlebotomus flies popularly though erroneously called "sand fleas" include a number of small hairy midges about a pinhead in size. In most species only the female sucks blood and though the insects are minute their bite causes very severe irritation. The phlebotomus papatasii is of medical and military importance because of its ability to transmit sand-fly fever. The fly breeds in dark damp cellars, caves, dugouts, cracks and fissures in soil, under stone walls, etc. Moist organic matter as well as shelter and darkness are essential. Adult flies shelter in similar situations. These midges are active after twilight, they are repelled by sunlight though attracted by feeble artificial light. They are unable to fly against the slightest breeze.

One fly may infect. The patients blood is infectious for the first twenty-four hours of the disease and the midge becomes infectious seven days after its blood meal. Once infected, the fly remains so for life which may be from twelve to twenty-five days.

Control. Persons may be protected by applying pyrethrum fly spray to the exposed parts of the body. The fly spray should also be painted on the screening each evening since the midges are able to pass through an 18 mesh screen. Where electric fans are available they should be installed to produce strong air currents at the windows and doors. Elimination of nearby breeding grounds is a satisfactory control measure since the midges have a short flight range. Drainage and filling operations produce an unfavorable dry environment. Stone walls should be faced with mortar or cement to eliminate crevices and cracks in the ground should be filled in.

CHAPTER XV

VENEREAL DISEASES

The venereal diseases are most frequently transmitted from person to person by direct contact during sexual intercourse. They include syphilis, gonorrhea, chancroid and lympogranuloma venereum.

These diseases are very prevalent in every community and do a great deal of damage not only to the individuals affected but to the community by reason of invalidism and premature death. More than 60,000 of the first 1,000,000 men who underwent physical examination for Selective Service in 1941 were rejected because of syphilis or gonorrhea. Prevalence of gonorrhea among civilians has been set at 1,037,000 cases of acute diseases annually. This makes gonorrhea more common than any other serious communicable disease. There is a wide variation in incidence of syphilis among various population groups. Analyses of serological and clinical examinations of 1,070,000 selectees and volunteers as of April 15, 1941, indicate a total of approximately 48,500 cases of syphilis. For white selectees and volunteers for whom reports were submitted, the rate was 18.5 per thousand; for negroes, 241.2 per thousand.

The following table shows the incidence of venereal diseases in the Army of the United States during the 1st World War:

Venereal Diseases, Officers and Enlisted Men,
Army of the United States in the
United States and Europe, April 1, 1917 to
December 31, 1918

Country	United States		
		Enlisted Men	
Class	Officers	White	Colored
Total of mean annual strengths for the period	124,266	1,965,297	145,826
Cases	1,148	198,727	84,867
Rate per 1000 per annum	9.24	101.12	881.94
Days absent from duty	42,701	3,691,990	1,082,759

Country	Europe		
		Enlisted Men	
Class	Officers	White	Colored
Total of mean annual strengths for the period	73,728	1,469,656	122,412
Cases	2,043	41,011	7,032
Rate per 1000 per annum	27.71	27.91	57.45
Days absent from duty	60,083	1,359,297	207,661

It is highly probable that every person who indulges in promiscuous sexual intercourse sooner or later acquires one or several of the venereal diseases. Competent medical reports over more than a quarter of a century indicate, without exception, that from 50 to 90 percent of all prostitutes are infected with syphilis, gonorrhea, chancroid, lymphogranuloma venereum or more than one of these diseases. In 1917, in a large Pacific Coast city, 97 percent of the prostitutes were found to be infected with venereal disease. In a city on the Atlantic coast, 96 percent of the prostitutes had venereal disease. These statistics give an indication of the difficulty in avoiding infection among persons who practice promiscuous sexual indulgence.

Venereal diseases, next to respiratory diseases, have practically always been the most important cause of admission to sick report in the Army. Figure 66 shows the occurrence in the Army 1819 to 1940, inclusive, with the exception of two periods—1832-1837, 1947-1848—for which there are no records.

Description of the venereal diseases. *Syphilis.* The first manifestation of this disease appears at the site of, and within a month after, the inoculation. The causative agent, the Treponema pallidum, is a spirally shaped, actively motile micro-organism. It is present in all the early lesions and has been found many times in the later stages of the disease. It is able to enter the skin or mucous membranes through a very minute break in tissue continuity. Mankind is universally susceptible to the disease and no immunity is conferred by an attack. The disease appears first as a small red spot which slowly enlarges until the tissue dies at the center so that an

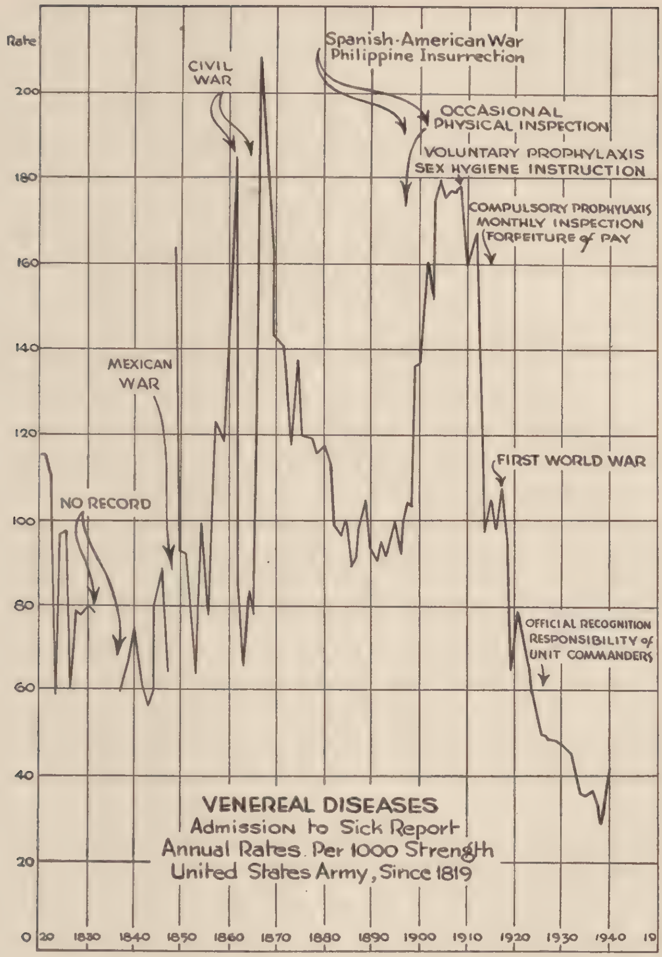

Fig. 66.

ulcer is formed. The ulcer is circular or oval in shape, regular in outline, the edge is somewhat raised, considerably hardened and sloping toward the base; the base reddened, often raised slightly above the level of the edges and secreting a thin watery fluid. The sore is usually, but not always, painless. The lymph nodes in the immediate drainage area be-

come enlarged and hard but do not suppurate. The patient's general health is usually good during this first stage of the disease. There is evidence, however, that the causative organisms are disseminated throughout the body at this time.

The second stage of the disease begins between six and twelve weeks after the first appearance of the primary lesion. It is characterized by fever which may be mild or severe, anemia that is sometimes grave, a rash on the skin, frequently falling of the hair, sore mouth and sore throat, enlargement of the lymph glands, pains in the extremities, particularly in the joints, and other but less common affections of many parts of the body. These evidences of the disease may all appear within a relatively short time, one or two years, or they may occur many years later.

The third stage of this disease may overlap the secondary stage or its appearance may be delayed for from two to twenty years. It is characterized by ulceration and destruction of the deeper layers of the skin, the formation of growths peculiar to the disease, gummata, in the bones, skin, mucous membranes, brain, liver, lungs, heart, kidneys, testicles, and muscles. In the skin and mucous membrane these growths often ulcerate, causing large, slowly healing sores.

Locomotor ataxia and general paresis are syphilitic affections of the cerebro-spinal nervous system occurring late in the course of the disease and often spoken of as constituting a fourth stage.

This disease is unlike the acute communicable diseases in that the individual once having become infected is never thereafter free from it, unless he undergoes a prolonged and an exacting treatment to effect a cure. He may be a constant or periodic source of infection, almost certainly so unless competently treated. If he infects his wife his disease may be transmitted to his children. The clinical course of the disease is frequently incapacitating. He never can be free from worry as to his physical and mental condition. The disease is unlike most other communicable diseases in one most fortunate respect: there is a specific treatment for it which will, when properly administered by the physician and zealously follow-

ed by the patient, result in a complete cure in a high percentage of cases.

Gonorrhea. This disease is primarily an acute infection of the urethra affecting both the male and female. It tends to become latent and chronic and to affect many parts of the lower genito-urinary system other than the original area of infection. The infection is caused by a specific bacterium, Diplococcus gonorrhoeae. This organism can live but a short time outside the human body, being almost strictly parasitic. It is quickly destroyed by drying or by the application of weak antiseptic agents. Man is universally susceptible to this disease. An attack confers, at the most, but a transitory immunity.

Chancroid. Chancroid is a contagious ulcer of the genital region caused by the bacillus of Ducrey. The disease does not spread beyond the genital region, but here it may cause considerable tissue destruction. The lymph nodes in the inguinal region are always affected by the disease and frequently suppurate. Many times the ulcers are multiple. This sore is spoken of as a soft chancre in contradistinction to the hard chancre of syphilis. Both diseases are often present in the same ulcer. Chancroid does not have the serious complications or sequelae of syphilis and gonorrhea but the disfiguring damage done to the external genitalia may be considerable.

Lymphogranuloma venereum. This so-called "fourth venereal disease" is a subacute infectious condition involving chiefly the lymph nodes in the inguinal region. It is more common in tropical than in temperate climates. The cause of the disease is probably a virus although the specific causative agent has not yet been demonstrated. Its transmission is by direct contact and almost exclusively by sexual intercourse. The discharges or secretions of the lesions are infective. The disease manifests itself from one to four weeks after exposure, by the appearance of a small, superficial ulceration on the external genitalia. The primary lesion is usually painless and transient, disappearing in a few days and may be so small as not to be detected. About one or two weeks later, the inguinal lymph glands swell up—they then break down with the formation of indolent, discharging sinuses. There may be fever, prostration. Elephantiasis of the

penis and scrotum may occur due to blocking of the lymph spaces by the large glands. The condition is very difficult to treat.

Prevention. *General.* Unlike many other communicable diseases in the control of which there has been considerable success, the venereal diseases present a special problem. In the preponderance of instances they are indissolubly associated with prostitution and this in itself necessitates an attack of the problem of control from two different angles: the one directed toward the female participant in the sex relationship, the other the male participant.

If all men and all women now suffering from venereal diseases could be cured of these diseases, meanwhile being kept from sexual experience, the solution to the problem would be relatively simple, for venereal disease would perish. But it is the difficulty in completely curing the individual that facilitates spread. This explains the great source of danger which lies in the prostitute. Many prostitutes undergo periodic examinations to determine whether or not they are free from venereal disease, but though a medical inspection of a prostitute might not reveal such disease there is no assurance that she is free of the disease at the time and certainly not during the interval of examinations. Moreover, numerous though the professional prostitutes are there are, perhaps, just as many who practice prostitution clandestinely and who are not even subjected to the periodic inspections of the others which makes matters infinitely worse.

Entirely aside from the moral aspects of the matter, the responsibility of the company commander as regards the men of his command consists in striving to retard them from possible contacts that might result in venereal disease. The majority of soldiers are of an age when the sex instinct is at its maximum; furthermore, they are for the most part single and suffer by reason of the fact that it is difficult for them to associate with chaste females. By educational means the officer can make the soldier acquainted with the nature of venereal diseases, the greater chance of his acquiring them than not when he exposes himself to them by consorting with prostitutes, and with the necessity for promptly taking prophylatic treatment following exposure. By providing interesting distractions, such as recreation, amuse-

ments, and attractive club or reading rooms, he can reduce materially the opportunities of enlisted men for exposure to venereal diseases.

The salutary influence of venereal disease control measures on the incidence of syphilis is well brought out by the low syphilis rate prevailing in our armed services. The annual rate for syphilis in the army was 17.56 per 1000 in 1918. This rate dropped progressively to 6.59 in 1939, 5.7 in 1940 and in August, 1941 it dropped to 5.5.

Prophylaxis. The venereal diseases may be prevented by proper prophylactic measures. Some of these are mechanical in nature, others are chemical. They prevent contact with the infectious organisms or secure their removal before they have an opportunity to penetrate the skin or mucous membranes or effect their destruction.

The condom is effective in avoiding gonorrhea since it prevents contact with the urethral opening, which is the initial site of this infection in most instances in the female and always so in the male. It is not so valuable as a protective measure against syphilis or chancroid or lymphogranuloma venereum since it may not entirely cover the shaft of the penis and does not prevent contact of adjacent parts of the bodies of the couple.

Urination immediately following coitus will carry away many germs which may have been deposited in the urethral opening. It is of considerable importance in preventing gonorrhea in the male, somewhat less so in the female.

Cleansing with soap. Soap is a valuable germicidal agent. It kills the venereal disease germs promptly. A thorough but not too vigorous cleansing of the genitalia and the adjacent areas with soap suds is a highly efficient protective measure.

Chemical Prophylaxis. The germs of all four venereal diseases are readily destroyed by the chemicals in general use as antiseptics. The agent used for this purpose must be mild in its action; otherwise the genital mucous membrane will be injured. The organic salts of silver, bichloride of mercury and 33 percent calomel ointment are those generally used. The chemicals must

be applied before the germs have had time to make their way into the mucous membrane or skin. The value of chemical prophylaxis decreases very rapidly with the time intervening between intercourse and application.

Venereal prophylatic treatment in the Army. Army regulations require that every individual who has had illicit sexual intercourse shall receive prophylatic treatment upon his return to the post.

In order for the chemical prophylaxis to be most effective in preventing venereal disease, it must be properly applied. Experience has shown that while the prophylactic treatment can be self-administered by the individual and will afford protection against venereal disease when properly applied by the individual, nevertheless, the best results are obtained when it is administered by trained personnel at a venereal prophylactic station. Consequently, venereal prophylactic stations are, as a rule, established wherever troops are assembled, and all military personnel who expose themselves to venereal disease must report to a prophylactic station for prophylactic treatment.

Restrictive and deterrent measures. The restrictive and deterrent measures employed in the control of venereal diseases consists of penalties for failure to report the disease when present and forfeiture of pay while incapacitated for duty because of venereal disease. These measures not only tend to deter men from indulging in illicit sexual intercourse, but they are also of great value in inducing them to report for prophylatic treatment as soon as possible after exposure.

Physical inspections for evidence of venereal disease. In many instances, venereal disease is intentionally concealed, perhaps because of a sense of shame or to avoid loss of pay while absent from duty or to escape the restrictions during the infectious stage. Such concealment deprives the individual of treatment, or if he receives treatment from a civilian physician, it subjects him to the harmful effects resulting from the performance of duty during the acute stages of the disease.

Physical inspections are conducted by medical officers, preferably in the presence of an officer of the company or other unit being inspected. As a rule, they are held in the barracks or tents of the unit. It is essential that the men inspected be checked by a roster of the organization and that the inspection include all enlisted members of the command, except married men of good character. Noncommissioned officers are inspected separately.

CHAPTER XVI

MISCELLANEOUS DISEASES

Tetanus. Tetanus or lockjaw is a specific disease caused by the tetanus bacillus. All deep wounds, especially those caused by gunshot, compound fractures and puncture or stab wounds are prone to be complicated by tetanus, as are extensive burns and wounds in which foreign bodies are lodged.

The risk of contracting tetanus from any type injury in which the skin is broken is increased many times if the skin of the injured area or the implement causing the injury is contaminated with soil or street dirt. Injuries that occur in the vicinity of stables are more hazardous, as the tetanus organism is often present in manure.

The tetanus bacillus is readily destroyed by ordinary antiseptics, however, the spores of the organism are extremely resistant to heat or antiseptics. The spore can live in the soil for years and be carried long distances in dust. When the spore finally becomes lodged in a warm, moist, oxygen-free site it grows, reproduces, and excretes its poisonous toxin. The toxin has a great affinity for the nerves of the body. Frequently it first affects the nerve supplying the muscles of the jaw, causing the jaw to become set and rigid. As the toxin spreads the irritability of the nervous system increases over the entire body and causes intense spasms and rigidity. The mortality rate is very high. Everyone is susceptible to the disease. It should be remembered that the size and appearance of the wound is not related to the severity of the disease; a small insignificant wound contaminated with dirt or manure may result fatally. Symptoms of the disease may appear 24 hours after the injury or may be delayed three weeks or more.

Control measures. Active "safety first" advice will help prevent injuries. The application of good first-aid treatment will assist in avoiding many of the various complications of wounds. Specific control depends on the care of the wound and the administration of tetanus antitoxin.

Military personnel do not receive tetanus antitoxin unless they have not been previously vaccinated with tetanus toxoid or unless they have not completed the three injections included in the initial vaccination, or unless their records of vacanation are lost or not available. Members of the Service who have been properly vaccinated with tetanus toxoid receive instead an emergency stimulating dose of toxoid.

Any wound that is likely to harbor the tetanus bacilli should be treated by a medical officer.

As a first-aid measure, foreign objects should be removed and the wound left wide open. It should be well swabbed with iodine solution and lightly packed with gauze.

Rabies. Rabies is a communicable disease of animals. It may occur in any animal but is most prevalent among dogs. In the dog the disease occurs in two general forms:

The furious or excited type where the animal runs wildly about biting any nearby objects, person, or animal. The dumb or depressed type which produces early muscular weakness and paralysis.

Many animals exhibit mixed symptoms, but the furious type predominates in about 80 to 85 per cent of cases in dogs.

The virus or organism of rabies is transmitted by inoculation with saliva through a wound or abrasion of the skin or mucous membrane. Usually the saliva is injected into the skin by biting but it may be transmitted by the licking of injured skin surfaces while one is handling a sick animal. The organism cannot be transmitted through unbroken skin or by ingestion of contaminated food or drink or by body lice or mites. While the disease occurs in cats, squirrels, rats, wolves, coyotes, foxes, horses, cattle, sheep, and swine, these animals are not common sources of infection for man. In Trinidad a vampire bat is able to transmit a highly fatal paralytic form of rabies to man. From 15 to 60 percent of persons bitten by rabid dogs develop the disease. The mortality is very high. Hysterical simulation of rabies is not uncommon.

Control measures. Control of rabies depends on: The prevention of the disease in dogs; the treatment of wounds;

the prophylatic treatment to prevent the development of the disease.

Dogs may be protected against rabies by specific vaccination. The immunity conferred is of variable duration. At military stations dogs should be vaccinated yearly.

When a dog is exposed or suspected of being exposed to the infection, two doses of the vaccine should immediately be given and the animal held in quarantine for one month. If vaccine cannot be given the dog should be held in quarantine for six months at least.

Treatment of wounds. The ordinary antiseptics are of little value and should not be relied upon. The patient should be placed under the care of a competent physician immediately. The wound must be cauterized with a powerful chemical agent, fuming nitric acid. The treatment is so painful that general anesthesia may be necessary.

Vaccine. In districts where rabies is present the prophylactic treatment should be given to all persons who are bitten by stray or unknown dogs. The dog should not be killed but should be captured and observed for ten days. If no symptoms develop in the dog during this time the course of treatment instituted in the patient can be discontinued. The immunity conferred by one course of the vaccine is short. Therefore, if a person is again bitten the treatment must be repeated.

Gas Gangrene. Gas gangrene is an acute and highly fatal disease, occurring frequently in wounds which are badly contused and contaminated with human or animal waste. The infection is especially liable to occur in compound fractures and large crushing or tearing wounds that come in contact with soil, but it has occasionally followed puncture wounds or small abrasions. The disease is characterized by a rapid spread of the infection through the muscle tissue and the production of a large amount of gas that can be felt through the skin. The gas imparts a foul odor to the wound.

Control. Every person receiving an extensive wound should be placed in hospital and the specific vaccine adminis-

tered. As this is one of the most rapidly fatal diseases, extensive and radical surgical procedures are usually necessary.

Erysipelas. Erysipelas is an acute infectious disease of the skin. It is caused by the entrance of organisms into the crevices and lymph channels of the skin. The skin abrasion is usually very slight. Streptococci, the bacteria producing erysipelas, are widespread in nature and are abundantly present about the nose and mouth, and on the hands. It is probable that the almost universal habit of rubbing the mouth, nose, and face with the hands and of picking at small insignificant abrasions are sometimes responsible for carrying the germs into the skin. The disease has often followed the plucking of hairs from the nares. The most common area to be affected is the face, usually in the neighborhood of the nose whence the disease may spread over the head and neck. The involved area is red, swollen, hard, and well circumscribed. The average duration is from ten days to two weeks. Recurrences are very common.

Control. The methods of infection mentioned in the preceding paragraph should be avoided by attention to personal habits. As in other contagious diseases, isolation and disinfection are the most important prophylactic measures.

Boils and Carbuncles. A boil or carbuncle is an acute pustular infection of a hair follicle or oil gland in the skin. It is caused by bacteria normally present on the skin and occurs because the resistant power of the skin has been lessened by an irritation or injury. Often the original lesion is followed by others due to the pus having been rubbed into the skin by the hands, by towels, or by the clothing. Boils occur most frequently on the face, back of the neck, and the forearms.

A carbuncle is a localized pustular infection in the deep layers of the skin. It usually remains as a single lesion. The most common location is at the back of the neck, where dirt and infection are massaged into the skin by the movement of the neck against the collar. Carbuncles produce severe symptoms such as high fever, great pain at the site, joint pains, and prostration.

Control. Strict improvement of personal hygiene will

prevent the spread of these conditions. As the infection is spread through close contact with the infected person or his contaminated articles, special attention must be paid to bathing, cleaning of linen and soiled clothing, sanitation of barber shops and hygiene of the hands and skin. All cases require medical treatment.

Acne. Acne is a chronic infection of the oil glands of the skin, affecting chiefly the face, chest, and back. The infection arises after the openings of the ducts of oil glands have become closed with waste materials, as they are prone to do when the skin is not kept clean. Exposure to dirt and oil together with poor personal hygiene, especially lack of bathing and too infrequent change of clothing will often induce or prolong this condition.

Control. Hygienic measures such as cold and cleansing baths, outdoor exercises, frequent change of clothing and a well regulated hygiene of living are important. A well balanced diet, careful avoidance of digestive disturbances and avoidance of constipation are necessary in the prevention of this disease.

Scabies. Scabies, frequently spoken of as seven year itch, is an acute inflammatory condition of the skin due to the presence of the itch mite. The female itch mite burrows into the skin in order to lay her eggs and dies after laying from 25 to 50 eggs. The eggs hatch in five days, producing immature forms which remain in the skin until completely developed. The activity of the mites is greatly influenced by temperature; active burrowing takes place only when the skin is warm.

Scabies is an important condition because of its adverse effect on the morale and efficiency of the individual and group. It entails the loss of about ten days' time for treatment of ordinary cases. Complicated cases are frequently in the hospital for several weeks.

Transmission. The source of the infestation is always the person with scabies. Direct contact is the common mode of transfer but indirect contact through clothing, blankets and personal equipment may occur.

Symptoms. The parts most affected are the nails of the fingers, backs of the hands, wrists and arms, lower part of

the abdomen, buttocks, groin, and genitals. Itching between the fingers and upon the back of the hands is usually the first symptom. The itching is very intense, especially at night. The burrows made by the mites are not always easily discoverable. They are most easily seen when present in the finger webs. They consist of straight or tortuous lines ending in small elevations. Along the lines are small black dots, the excreta of the female.

Control. Prompt and correct diagnosis of scabies is essential in the control of this infestation. There is a tendency when scabies is known to be present in a group to consider all skin irritations as such. Eradication of existing infestation depends on proper diagnosis and disinfestation of the skin clothing, and blankets.

Special measures. Group quarantine should be established for all patients until treatment is completed. Men who have received treatment should be inspected ten days after completion of the treatment to be sure all infestation is destroyed. All clothing and blankets of men having scabies should be disinfested by the method employed for delousing.

Disinfestation of the skin. Disinfestation of the skin is accomplished only by treatment that destroys all forms of the parasite. Bathing with hot water, using green soap well scrubbed in for ten or fifteen minutes, is essential to remove the crusts and scales. The soap is then removed with hot water and the body thoroughly dried. Sulphur ointment is then thoroughly applied to the entire body.

Ringworm. Ringworm is a highly contagious, chronic disease of the skin produced by several species of fungi belonging to the genus Epidermophyton. It occurs most commonly on the face, hands, and feet, and about the genital regions. The objective characteristics of the disease are modified by the nature and condition of the skin in the various parts of the body. On the face and hands it appears as a small raised reddened area in which itching is intense. The lesion spreads radially, clearing up in the central portion as it progresses, then giving after a time a ringed or festooned appearance. The itching causes scratching, and shortly secondary infection by the pus forming bacteria normally present on the skin takes

place. On the face, scrotum and lower abdomen the hair retains the secretions, leading to the formation of thick crusts. Between the toes, the softened condition of the skin leads to the formation of blisters. Ringworm of the bearded region is known as barber's itch, of the feet as athlete's foot, and of the genital region as dhobie itch. The disease is more widely prevalent in warm weather. Long periods of quiescence, simulating recovery, are common.

Importance. This disease causes about 2 per cent of admissions to sick report (excluding those due to injuries). Its occurrence shows a tendency to increase.

Transmission. The primary source of the infestation is the individual who has the disease. The fungi are disseminated by direct contact and by indirect contact through such media as barber's tools, floors, mats, benches of bath houses and swimming pools, infested equipment in gymnasiums and clubs, towels, soap, shoes, underclothing, and sleeping garments.

Control measures. *Disinfection.* The most effective measure in the control of this disease is disinfection of bath house floors and equipment and sterilization of towels, swimming or gymnasium suits, and similar articles that may harbor the infection. Bath house floors and equipment should be scrubbed daily with strong soap suds in shower baths. There should be removable standings (duck -boards), which should be made in small sections so that they may be easily taken out and exposed to the sunlight for several hours each day. Articles that can be boiled should be sterilized by boiling. Rubber and leather goods can be cleaned with cresol solution. A one per sent solution of thymol in gasoline or alcohol will disinfect shoes. The solution should be poured into the shoe and allowed to evaporate.

Inspection of feet. The feet of all men should be carefully inspected at the regular monthly inspections. Where a considerable number of cases is present, special inspections should be made for the purpose of detecting mild cases.

Sanitation of swimming pools. Swimming pools to which troops have access should be considered satisfactory only when regulations and facilities thereof provide:

1. For a restriction on the current number of bathers.
2. For through cleansing of the body prior to entering the pool.
3. For the use of a disinfectant solution consisting of high test calcium hypochlorite, in the proportion of one ounce to one gallon of water, for the feet of the bathers.
4. For the exclusion of those who are ill.
5. For the continuous disinfection of the pool water.

Plant Dermatitis. The poison ivy, poison oak and poison sumac are the common plants that produce skin irritation in susceptible people.

The poison ivy is distinguished from other suspected creepers of a similar appearance by its possession of three leaflets instead of five.

The poison oak, commonly found in the western part of the United States, is a shrub or small tree.

The poison sumac, also known as poison elder or dogwood, is a shrub or small tree growing in swampy places.

Transmission. The harmful part of these plants is the resinous sap which exudes from all injured surfaces. It is now certain that the poison is not volatile, as was once supposed. Actual contact with the sap is necessary; however, contact with the plant may not be essential as the sap can be carried on clothing, tools, hands or transmitted on the bodies of insects, or in the smoke coming from fires burning the plants. Sap particles carried in any of these ways soon lose their toxic properties by drying. This loss is more rapid at body temperature and in a moist atmosphere. The poison is soluble in alcohol and alkalies.

Symptoms. Within a few hours after exposure the skin becomes red and irritated. Small blisters from and later rupture to leave a moist raw surface. The lesions are most marked on the backs of the hands and forearms. The face, primarily or secondarily, is usually involved. In men the genitals frequently become involved due to the poison being conveyed there by the hands.

General control measures. One should learn to recognize the plants and avoid them when possible. In occupied

areas the plants should be destroyed. Exposure may be diminished by requiring all men working in or about the plants to:

1. Wear gloves while at work.
2. Change outer clothing and gloves before associating with the other men in the camp.
3. Keep contaminated tools and implements separate from uncontaminated implements.
4. Burn poisonous vegetation at a considerable distance from the camp site and always at such time and place that the wind will carry the smoke away from the camp.

If possible choose camp sites where poisonous plants are not present.

Personal measures. Contaminated clothing and implements should be well washed with water (soda water if possible) or exposed to the direct rays of the sun for several hours.

All parts of the body that have been exposed to the plants should be well washed with a strong soap solution or alcohol. Gasoline or kerosene may be used. The washing must be prompt and thorough, or else it will tend to spread the poison.

Where the lesions are more than 24 hours old it is best to apply a weak solution of potassium permanganate or ferric chloride. The lesions are then best treated with a mild lotion or a soothing powder.

INDEX

Carlisle Barracks, Pa., 7-14-42—1,500